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# UTTAR PRADESH DIVERSIFICATION OF AGRICULTURE SUPPORT PROJECT

## ECONOMIC AND FINANCIAL ANALYSIS

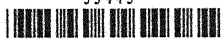
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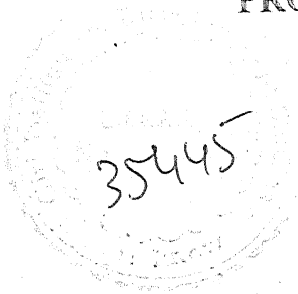
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## PREFACE

*The Uttar Pradesh Diversified Agriculture Project was launched by the Government of U.P. in September 1998 with World Bank assistance. The first phase of the project was to come to an end by 31<sup>st</sup> March 2004. The present study was sponsored by Project Coordination Unit of UPDASP to carry out an economic and financial analysis of the project and its major components.*

*Many debts have been incurred by us in the conduct of this study. First and foremost we are thankful to Dr. S.P. Singh, IAS, Project Coordinator, UPDASP for sponsoring the study and providing all necessary support and help in the conduct of the study. We are also thankful to the officers of UPDASP, particularly Shri P.K. Agarwal, Chief Manager Finance, for providing us required data about project activities and detailed discussions on specific aspects of the project.*

*Most of the data for the economic and financial analysis used in the study have been supplied by Agricultural Monitoring Centre, IIM, Lucknow. Without this set of data economic and financial analysis of the project would not have been possible. We are extremely thankful to Professor R.P. Singh, Director AMC and Dr. Ravikesh Shrivastava, Associate Professor in the AMC for their invaluable help and cooperation at all stages of the study.*

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*Lucknow  
April 28, 2004*

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## OVERVIEW

### Project Aims and Activities

1. The Uttar Pradesh Government launched The Diversified Agriculture Support Project (DASP) with World Bank assistance in 1998-99. The project aims to accelerate the growth of diversified agriculture in U.P. in relation to agro-ecological potential and market demand, with an emphasis on production systems and delivery mechanism that benefit the farming community. The expected benefits of the project included increased opportunity for rural employment leading to poverty reduction, sustainable management of land and water resources and capacity building. Growth was expected to be enhanced by improved technology and policy environment as well as supporting investment in rural infrastructure. Poverty reduction was expected to be brought about mainly by raising farm family incomes and reducing risk by offering a larger menu of alternative technologies to a broad cross section of farming community and through increased local participation and employment opportunities. Sustainability was expected to be enhanced through the improved plant nutrient and pest management practices. Capacity to manage diversified agriculture was to be developed through the training programmes at all levels as well as improvement in institutional capacity to manage these programmes.

2. The project activities aimed at supporting a Farming System Approach with major emphasis on natural resources management, employment generation, value addition and marketing support through participatory management process. Large-scale demonstrations on Integrated Plant Nutrient Management (IPNM) and Integrated Pest Management (IPM) were conducted in the selected villages. The demonstrations aimed at balanced use of nutrients, agro-chemicals, improved crop rotations and improved soil analysis capacity with a view to check excessive use of hazardous chemicals and reduce their negative impact on soil and ground water. A number of new innovations such as Bio-Villages with emphasis on introducing organic farming with integrated bio-dynamic practices, vermi-compost, seed village, etc. have also been launched in a modest way.

The Project laid emphasis on introduction of new plant genetic material for enhancement of production and productivity in fruits and vegetable, including off-season vegetables.

3. Another major component of the project was livestock breed conservation programme. Promotion of hygienic milk production and processing and marketing of milk products were also one of the thrust areas to enable the provision of safe milk and milk products.

4. The project also aimed at supporting and improving basic rural infrastructure, such as, rural roads, *haats* and *painths* (local markets), cattle and horticulture markets for promotion of value addition and marketing capabilities in the project area.

### **Project Strategy**

5. DASP strategy was based on five main components: technology development, establishment of a demand driven technology dissemination system, increased private sector participation and public-private partnership, development of rural infrastructure and economic policy analysis activities. The key features of these components of the strategy are briefly described below.

#### **Technology Development**

- (a) Enhancing research co-ordination;
- (b) Establishment of a Competitive Agricultural Research Programme (CARP) to support time bound adaptive research on priority constraints, to increase productivity of the marginal farmers; and,
- (c) Strengthening of research support for technology dissemination activities.

#### **Establishment of a Demand Driven Technology Dissemination System**

- (a) Rationalisation, reorientation and strengthening of line departments to service a demand driven system;
- (b) Increased participation by the private sector in input supply and support services;
- (c) Increased participation by the farming communities mobilized with the help of Non-Government Organizations (NGOs); and,

- (d) Support for human resource development and greater use of information technology in technology dissemination.

#### **Support for Increased Private Sector Involvement in Agri-business Development**

- (a) Credit mobilisation and facilitation;
- (b) Provision for establishment of Project Development Facility to mobilize private sector initiatives and promote vertical integration of marginal farmer with private investment in input supply and post-harvest value addition initiatives including agro-processing.

#### **Support for Rural Infrastructure Development**

- (a) Improvement of 2,700 kms of rural roads in the project districts;
- (b) Improvement and construction of 133 rural markets (*Haats* and *Painths*), 3 cattle markets and rehabilitation/establishment of two model fruits and vegetable markets under Mandi Parishad in project districts; and,
- (c) Support for Directorate for Agricultural Marketing to improve its market information collection and dissemination systems to benefit marketing activities of producers.

#### **Support for Project Management and Enhanced Capacity for Economic Policy Analysis**

- (a) Project Steering, Management and District level Committees to ensure effective oversight, policy guidance and management of the project;
- (b) Co-ordinate day-to-day implementation of project activities;
- (c) Indian Institute of Management, Lucknow (IIML) to act as an independent Monitoring & Evaluation agency; and,
- (d) An Economic Policy Analysis Unit to assist the Agriculture Production Commission (APC) branch in analysing agriculture policies and public expenditures.

## Project Interventions

6. Project offered following interventions in co-ordination with line departments:

Department of Agriculture	Integrated Plant Nutrient Management (IPNM) & Integrated Pest Management (IPM) demonstrations of farmers' field, organic farming and informal seed production and multiplication
Department of Horticulture	Varietal demonstrations and area expansion under horticultural crops, establishment of nurseries in private sector and rejuvenation of old fruit orchards
Department of Animal Husbandry	Extension of veterinary coverage through paravets, conservation of local breeds through establishing opening Nucleus Breeding Centres and Improved Cattle Feed Programme
Department of Dairy Development	Creating awareness towards production and consumption of pure and hygienic milk through training of milk vendors and organizing mass awareness camps
Department of Public Works	Construction of rural roads
Department of Panchayat Raj	Construction of rural markets and cattle markets.
U.P. Council of Agriculture Research	Funding under Competitive Agriculture Research Programme for short duration problem based research project and conduction of adaptive trials on farmer's field.

## Project Area

7. The project is being implemented in the State since September 1998 and was designed to close by March 2004. The project has been initiated in 157 selected blocks of 32 project districts, covering all the 8 agro-ecological zones – Tarai, Western Plains, Mid-Western Plains, South-Western Semi-Dry Plains, Bundelkhand, North-Eastern Plains and Vindhya, falling under 4 economic regions – Eastern, Western, Central and Bundelkhand. After the creation of a new Uttaranchal state in November 2000, part of the project area has now gone to Uttaranchal.

## Expenditure under the Project

8. An expenditure of Rs. 753.11 crores has been made under UPDASP since its inception till 31.3.2004. Component-wise expenditure has been shown in Table 1. In the first three years the progress of expenditure was slow. Nearly two-thirds of expenditure has been made during the last two years. Rural roads account for nearly two-thirds of the total expenditure under the project.

Table 1  
Componentwise Expenditure under DASP in U.P. and Uttaranchal  
(In Rs. Crores)

Sl. No.	Project Components	Upto 1999-00	2000-01	2001-02	2002-03	2003-04 Project -ed	Cumula -tive Expendi -ture
1	UPCAR/ Technology Dev	1.81	5.08	4.89	7.40	9.81	28.99
2	Agriculture	0.63	1.92	5.29	6.44	8.69	22.96
3	Horticulture	3.16	4.04	6.07	14.96	18.30	46.53
4	Agricultural Marketing Directorate	0.14	0.06	0.40	0.28	2.35	3.23
5	Sericulture	2.71	4.50	2.63	2.32	1.81	13.96
6	Animal husbandry	4.28	5.39	10.00	14.57	18.93	53.17
7	PCDF	0.34	0.86	2.36	2.78	6.16	12.50
8	PWD	25.78	59.35	71.80	154.47	160.45	471.85
9	Panchayati Raj	0.00	0.76	3.35	2.71	4.05	10.87
10	Mandi Parishad	0.01	0.05	0.00	0.45	0.00	0.51
11	SHGS/NGOS	0.00	0.00	1.36	5.59	4.03	10.98
12	Project Coordination Unit (PCU)	14.21	8.18	15.31	20.50	19.36	77.56
	Total	53.07	90.19	123.45	232.47	253.93	753.11

Source: Project Coordination Unit, UPDASP

9. For the purpose of calculating ERR project costs have been updated to 2003 prices on the basis of wholesale price index for India. The inflation adjusted figures of expenditure have been given in Table 2.

Table 2  
Componentwise Expenditure under DASP in U.P. and Uttaranchal at 2003 Prices  
(In Rs. Crores)

Sl. No.	Project Components	Upto 1999-00	2000-01	2001-02	2002-03	2003-04 Project -ed	Cumulative Expenditure
1	UPCAR/ Technology Dev	2.17	5.69	5.29	7.54	9.81	30.50
2	Agriculture	0.76	2.15	5.71	6.57	8.69	23.87
3	Horticulture	3.79	4.52	6.55	15.26	18.30	48.43
4	Agricultural Marketing Directorate	0.17	0.07	0.43	0.29	2.35	3.30
5	Sericulture	3.25	5.04	2.84	2.36	1.81	15.30
6	Animal husbandry	5.14	6.04	10.80	14.86	18.93	55.76
7	PCDF	0.41	0.96	2.55	2.84	6.16	12.92
8	PWD	30.94	66.47	77.55	157.56	160.45	492.96
9	Panchayati Raj	0.00	0.85	3.62	2.76	4.05	11.28
10	Mandi Parishad	0.01	0.06	0.00	0.46	0.00	0.53
11	SHGS/NGOS	0.00	0.00	1.47	5.70	4.03	11.20
12	Project Coordination Unit (PCU)	17.05	9.16	16.53	20.91	19.36	83.02
	Total	63.68	101.01	133.32	237.12	253.93	789.07
	Inflation Index 20002-03=100	1.20	1.12	1.08	1.02	1.00	

Note: Based on Table 1.

10. The inflation adjusted expenditure has been further adjusted by a factor of 0.9 for correction for border prices. The adjusted figures have been given in Table 3.

Table 3  
Border Price Adjusted Expenditure under DASP in U.P. and Uttaranchal at 2003 Prices  
(In Rs. Crores)

Sl. No.	Project Components	Upto 1999-00	2000-01	2001-02	2002-03	2003-04 Project -ed	Cumula -tive Expendi -ture
1	UPCAR/ Technology Dev	1.95	5.12	4.76	6.79	8.83	27.45
2	Agriculture	0.68	1.94	5.14	5.91	7.82	21.48
3	Horticulture	3.41	4.07	5.90	13.74	16.47	43.59
4	Agricultural Marketing Directorate	0.15	0.06	0.38	0.26	2.12	2.97
5	Sericulture	2.93	4.54	2.56	2.13	1.62	13.77
6	Animal husbandry	4.62	5.43	9.72	13.38	17.04	50.19
7	PCDF	0.37	0.87	2.29	2.55	5.54	11.62
8	PWD	27.84	59.82	69.79	141.80	144.40	443.67
9	Panchayati Raj	0.00	0.77	3.26	2.49	3.65	10.16
10	Mandi Parishad	0.01	0.05	0.00	0.41	0.00	0.47
11	SHGS/NGOS	0.00	0.00	1.32	5.13	3.63	10.08
12	Project Coordination Unit (PCU)	15.35	8.25	14.88	18.82	17.42	74.72
	Total	57.32	90.91	119.99	213.41	228.53	710.16

Note: Border price adjustment has been made by using a correction factor of 0.9.



## **The Present Study**

11. The objective of the present study is to undertake post-project economic and financial analysis of project activities to assess the economic and financial viability of the project and to calculate the economic rate of return (ERR) of the various project components and the overall project.

## **Data Source**

12. Two sets of data sources have been used in the analysis. First set of data covering component wise expenditure and physical achievements under different components for the project period has been obtained from the Project Coordination Unit (PCU) of DASP. The second set of data has been obtained from the three Impact Studies of the project by Agriculture Monitoring Centre (AMC) of the Indian Institute of Management, Lucknow, which was entrusted the task of monitoring and evaluation from the beginning of the project. The three impact studies pertain to the base year (1998-99), 2001-02 and 2002-03. In addition, AMC was requested to carry out a quick sample survey of about 500 farm households in the project districts to collect required information on economics crops and animal husbandry. The survey was carried out in November-December 2003. The results of the survey have been utilized for calculating ERR of agriculture and animal husbandry sector. Another survey was carried out by AMC during February-March 2004 to collect data of traffic flows in four selected districts in the project area. This provides the basis for calculating ERR of rural roads.

## **Methodology for Calculating ERR**

13. The standard benefit cost analysis technique has been used to calculate internal rate of return of the project and its components. Broadly the methodology used in the Project Implementation Report, Vol. IV for economic and financial analysis has been used. Some adjustments were made as and when needed in view of the nature of data available for analysis. The analysis has been carried out at 2003 prices. All the costs and benefit values have been converted into 2003 prices. Corrections have been made for border prices using importable hypothesis. In case of traded items like fertilizers, wheat and paddy border prices have been used. For other input and output items a uniform correction factor of 0.9 has been used as was done in the Project Implementation Report (PIP). Details of methodology for different sectors have been given in the following

chapters. A brief account of the methodology and results for different components has been given in the following paragraphs.

### **ERR for Agriculture Sector**

14. Project activities under agriculture sector aimed at technological upgradation through training of key staff, provision of high quality planting material, improvement in post-harvest technology. It laid emphasis on changes in the cropping pattern by introducing shift to high value added crops, use of integrated pest management technology and bio-fertilisers, etc. The calculations cover the major representative crops, e.g. wheat, paddy, maize, arhar, maize, mustard and vegetables (including potato). These crops cover almost 70% of gross cropped area. Fruit crops were excluded for want of cost and output data.

15. Following steps were involved in calculation of ERR for agriculture. First, the financial values of costs and output for selected crops as reported in AMC 2003 Survey have been converted into economic prices by using appropriate correction factors. The situation in non-project area is taken to represent the impact of the ongoing agricultural programmes. The assumption is that the difference in project and non-project situation captures the net impact of the project activities. The difference has been spread over five years using constant amount of change for each crop. Per hectare net income for selected crops in the project area has been assumed to be constant over the project period. Details of cropping pattern in project area and non-project area are taken from AMC Baseline (1998-99) and Impact III (2003-04) study. For intervening years percent area under each crop has been interpolated by adding one-fifth of total change in the intervening years under crop for the period 1998-99 to 2003-04.

16. The cropping pattern as calculated above has been applied to the average holding size in U.P. taken at 0.8 hectare. By multiplying percent area under the selected crops by GSA under six crops we arrive at the actual area under these crops on the average farm in the project and the non-project area. Net income per hectare under each crop has been multiplied by calculated area under the crop for each year in the project and the non-project area. By adding up the net income from six selected crops we get total net income per farm for each year. The difference in the net income per farm in the project and non-project area gives net incremental income per farm as a result of the project intervention.

17. On the basis of adoption rates of improved practices in the project area as reported in AMC Impact Study for 2003, it is assumed that about 20% of total beneficiary farmers or roughly 45,000 farmers out of 228,000 beneficiary farmers have adopted multiple practices propagated in the project. By multiplying net incremental income per farm by the number of beneficiaries we arrive at net income for agriculture sector, which is assumed to be constant after the 5<sup>th</sup> year. From the net income stream project overhead costs for each year have been deducted to give net incremental income from this sector.

18. **ERR is calculated at 20% for the agriculture sector and Net Present Value (NPV) at Rs. 320.26 million using a social discount rate of 12%.** As mentioned above, this does not take into account benefits from fruit crops and floriculture, etc.

19. Financial analysis of agriculture shows that the base year net income of Rs. 11,768 rises to Rs. 19,614 in the fifth year in the project area and to Rs. 12,972 in the non-project area. Net incremental income rises from Rs. 1166 in the base year to Rs. 6642 in the fifth year and then is assumed to be constant. Thus a shift in cropping pattern and higher yields due to improved practices promoted by project intervention lead to an increase of over 50% on an average farm of 0.80 hectare.

20. Seed cultivation has been promoted as one of the components of the project activities. By 2002-03, an area of 4037 ha has been brought under seed cultivation, mainly under wheat, rice, pulses and oilseeds. Gross additional gain from seed cultivation is calculated as the difference between the gross value of sale of seed output at market prices and the gross value of output of normal produce at MSP (Minimum Support Price), which is lower than market price of good quality seed. From the gross gain additional price paid for improved seed has been deducted to arrive at the net gain per hectare from seed cultivation, which is over and above the net gains from cultivation of normal crop. Other costs are assumed to be same in both situations. The calculated net gain per farm from seed cultivation amounts to Rs. 4549 in 2003-04. This is the additional income that an average farmer in the project area can obtain if he devotes entire area under the selected crops for cultivation of improved seeds over and above what he would get from cultivation of normal crop.

21. Economic analysis of fruit crops could not be done due to lack of data on output and cost items of different types of crops. An illustrative case of mango, the main fruit crop of U.P. plains has been worked out on the basis of cost and yield data supplied by Directorate of Horticulture U.P. Mango cultivation yields a net income of Rs. 40,000 per hectare per year from the tenth year onwards against a net income of Rs. 8200 per hectare from subsistence crops as reported by AMC survey). Thus by switching over from current subsistence crops to mango cultivation a farmer can earn a net incremental income of Rs. 32,000 from tenth years onward. ERR of mango cultivation for individual farmer comes to 30% over a 20 year span.

### **ERR For Animal Husbandry**

22. There are two main components of the livestock sector: (a) an A1 component and (b) an indigenous breed conservation and improvement component both supported by improved husbandry technology dissemination covering mainly cattle and buffalo. It is believed that due to the combined effect of A1, improved nutrition and health care, there would be incremental production of milk, which is the main benefit accruing from the project interventions.

23. The calculation of ERR for livestock sector has been based on the following sources of data: official field data on physical achievements pertaining to the livestock sector in the project area over a period of time (1998-99 to 2003-04) and Socio-economic Impact Surveys done by the Agriculture Management Centre (AMC). Figures of AIs (Artificial Inseminations) done during the last five years for cow and buffaloes separately have been taken from PCU. The number of calves born and lactating cows over the twenty-year period has been worked out as per the assumptions/method used in the PIP Vol. IV document based on herd model.

24. Milk yield per year per animal has been worked out on the basis of the surveys of AMC. For 2002-03 it is reported at 1100 lt. per cow in project area. Corresponding figure for buffaloes were 1430 lt. It is assumed that milk yield will increase at a rate of 3.5% per year as originally assumed in the project report. In non-project area milk yield is assumed to remain constant. Total milk production for different years has been derived by multiplying the number of lactating cows/buffaloes by average milk yield. The price

of milk is taken at 2003 prices prevailing in the domestic market as actually accruing to livestock owners as reported by AMC survey. It is taken Rs.10/- per litre for cow's milk and Rs.12/- per litre for buffalo's milk. No correction for international prices has been made following the project report methodology. The value of the incremental milk yield (with project minus without project) has been worked out using the above rates. This gives the incremental benefits of the A1 component.

25. For calculation of the costs two items have been taken into account: (i) maintenance costs (feed, fodder, health inputs, etc.) and (ii) A1 costs. Incremental maintenance costs, on per unit basis, have been taken from the AMC survey for project and non-project area for the reference year at 2003 prices.

26. From the above steps a stream of incremental costs and benefits spread over 20 years has been derived. The difference between incremental costs and incremental benefits gives the net incremental benefits of AI component.

27. For Breed Conservation and Development (BCD) Programme actual figures of AIs and Natural Service have been taken from PCU and as before herd growth has been built up over the years as per assumptions. For this programme also, benefits have been measured in terms of increased milk yield and incremental maintenance costs have been deducted to calculate net benefits.

28. Including the benefits from AI and BCD Components the **ERR for animal husbandry comes to 25.41% and the NPV @ 12% discount rate comes to Rs. 1909.11 mn.** It may be added that our calculations do not include additional benefits due to wool and sale of meat etc. If the above benefits are also included, the ERR of the project is likely to go up further.

29. A financial analysis has also been attempted to illustrate likely costs and benefits to farmers who switch over to improved breed of cows/buffaloes propagated in the project. Net annual income from an improved cow comes to Rs. 2880 against a net income of Rs. 1225 in case of local breed cow. Thus, a farmer can get an additional income of Rs.1655 per year if he keeps an improved breed cow against a local breed cow. Net annual income from an improved buffalo comes to Rs. 9392 against a net income of Rs. 7690 in case of local breed buffalo. Thus, a farmer can get an additional income of Rs.1722 per year if he keeps an improved buffalo against a local breed buffalo.

## **ERR for Rural Roads**

30. Under DASP nearly 2740 kms of rural roads have been constructed in the project districts of Uttar Pradesh and Uttaranchal at a cost of Rs. 4718.5 million during the period 1998-99 to 2003-2004. In order to calculate post- project benefits of roads a traffic survey was conducted by AMC during February-March, 2004 in four project districts in U.P., namely, Ghaziabad in West U.P., Barabanki in Central U.P. and Varanasi and Gorakhpur in East U.P. In each selected district twenty-four hour traffic flow of different types of vehicles was noted on four selected roads constructed under DASP in each of the district.

31. The following steps were involved in estimation of net benefit stream of rural roads per km. Weighted average of per km flow of different vehicles is estimated by adding total vehicles flow in a day in each district and dividing by the number of kms surveyed in the district. Since the survey was conducted in the final year of the project (2003-04), we derived the traffic flow for earlier years by reducing traffic flow by 5% each year for different types of vehicles. This gives us the profile of traffic flow by type of vehicle in the base year (1998-99). Base year traffic flow has been projected for later years on the basis of the following assumptions. In case of non-motorised traffic consisting of carts, cycles/ rickshaw/ pedal traully, an annual decline of five percent has been assumed till the tenth year as it is expected that with construction of improved roads this traffic will be substituted to some extent by motorized traffic. On the other hand, five percent annual compound growth rates have been considered for motorized traffic including bus, truck, car/jeep/ three wheelers, LCV, mini truck, and two wheelers till the tenth year. After the tenth year, traffic flow is assumed to remain constant as carrying capacity of roads will be reached. Same level of traffic has been assumed on the existing and the improved roads.

32. Per km operating costs for different types of vehicles have been taken from the Kadiyali report, which has used updated costs for 2003 based on Indian Road Congress (IRC) estimates for 1993. Total operation cost of different types of vehicles is estimated by multiplying the numbers of estimated vehicles flow with the per km cost of that type of vehicle. By adding operation cost of different types of vehicles we arrive at total operation cost per Km. per day. Total annual operation costs are then estimated by



multiplying per day cost by 365. It is assumed that operation costs correspond to PCI 1 (Present Condition Index), reflecting poor quality road on case of existing roads. Operation cost of improved project roads are taken corresponding to PCI 4 (good condition roads). Annual adjustment in operation costs has been made to reflect deteriorating quality of road till its major renewal in the tenth year.

33. Total annual saving of vehicle operation costs for all vehicles is estimated by subtracting the estimated costs per km for project roads from the estimated costs per km for the existing roads. This yields a stream of VOC benefits over a 20 year period. The net per km saving is adjusted by a factor of 0.9.

34. Costs consist of the construction cost and maintenance costs. The initial construction costs per km have been estimated dividing total expenditure on roads by the reported road length constructed. Cost of construction has been converted into 2003 prices on the basis of all India Price Index for Construction, which has been increasing at an average annual rate of 4%. For maintenance costs a norm of Rs. 25, 000 per km per year has been taken for project roads, which is assumed to increase by 5 percent per up to 10<sup>th</sup> year. The norm for existing roads has been taken at Rs.10, 000 per km per year and assumed to remain constant over time. It has been further assumed that rehabilitation of roads will be undertaken in the 10<sup>th</sup> year. Cost of rehabilitation has been taken as 25 percent of the construction costs. All costs have been adjusted with a factor of 0.9 to reflect border prices.

35. Net incremental benefit stream per Km for rural roads has been arrived at by deducting the costs (i.e. construction cost, incremental maintenance cost and rehabilitation costs) from the net benefit stream on account of VOC. We have derived per km. net income stream from rural roads for each of the five years of the project corresponding to the level of traffic flow estimated for these years. Net benefits for total roads constructed in the respective year have been derived by multiplying the net benefit stream of the year by length of roads constructed in the year. ERR is then calculated after deducting construction and rehabilitation costs from the net benefit stream. By adding up the net benefit streams for all the five years we arrive at the net benefit stream for the total roads constructed under the project between 1999 and 2004.

36. **ERR for rural roads comes to 36.83%. NPV at 12% discount rate comes to Rs. 4,954.46 mn.** It may be added that roads benefits have been calculated in terms of savings in vehicle operation costs as was done in PIP study. Other benefits of roads have been ignored. The reason for excluding other benefits like increased agricultural production was that it would amount to double counting since we have separately estimated the ERR for agriculture component.

### **Sericulture**

37. Sericulture component was not successful in U.P. and had to be abandoned mid-way. The coverage of area under mulberry is extremely low. AMC survey indicated that the returns to the farmer from sericulture are negative due to very low productivity and low prices received. For these reasons ERR for sericulture has not been computed. Costs incurred on sericulture are, however, included in the calculation of overall ERR of the project.

### **ERR of Overall Project**

38. To calculate overall ERR of the project we have added the net benefit stream of the three components (after deducting cost), namely, agriculture, animal husbandry and rural roads. To arrive at the net benefit stream of the project overhead costs and cost of sericulture and other items not included in cost of individual sectors have been deducted from total benefit stream. Post project administrative costs upto the tenth year have been assumed at 10% of the cost of the fifth year. Table 4 shows the net benefit stream of individual project components as well as that of the overall project. ERR of the overall project comes to 24% and NPV comes to Rs. 5578.90 million at 12% social discount rate.



Table 4: Net Benefit Stream and ERR of Overall Project

Year	Net Benefit Stream and Costs (Rs. Million)					
	Agriculture	Animal Husbandry	Rural Roads	Total Net Benefits	Total Costs	Net Benefit Stream Project
1	-6.2	-52.34	-58.18563	-116.7286	219.456	-336.1846
2	-46.61	-66.66571	-718.539	-831.8147	214.5024	-1046.317
3	-91.65	-136.2009	-306.2136	-534.0645	403.7494	-937.8139
4	-149.64	-222.3681	-585.4841	-957.4923	464.6916	-1422.184
5	-249.05	-268.2485	-776.9168	-1294.215	744.858	-2039.073
6	-271.79	-148.3708	1335.933	915.7717	19.045	896.7267
7	156.47	-164.4986	1423.248	1415.219	19.045	1396.174
8	192.36	-121.5829	1522.186	1592.963	19.045	1573.918
9	217.9	-29.6919	1633.818	1822.026	19.045	1802.981
10	232.55	120.5099	1759.335	2112.395	19.045	2093.35
11	275.05	312.7208	1885.508	2473.279	0	2473.279
12	275.05	565.2987	1860.742	2701.09	0	2701.09
13	275.05	806.1551	1911.402	2992.607	0	2992.607
14	275.05	969.3463	1826.593	3070.989	0	3070.989
15	275.05	1331.09	1591.547	3197.687	0	3197.687
16	275.05	1696.27	1692.17	3663.49	0	3663.49
17	275.05	2141.102	1764.612	4180.763	0	4180.763
18	275.05	2675.584	1840.676	4791.31	0	4791.31
19	275.05	3243.758	1920.543	5439.351	0	5439.351
20	275.05	3816.937	2004.403	6096.39	0	6096.39
IRR %	20.03	25.41	36.83			24.00
NPV Rs. Mn.	320.26	1909.11	4,954.46			5578.90

39. We may here compare the pre-project and post-project estimated ERR for the project shown in Table 5. Our estimate of post-project ERR of 24% is very close to the estimated ERR of 22% in PIP report. The estimated ERR for animal husbandry sector are also close in both the cases. However, post-project ERR for agriculture is much lower and for rural roads much higher than the pre-project estimates. Lower value of ERR in case of agriculture is due to the differences in the methodology followed. PIP estimates were based on farm models for different crops and regions and the values of productivity for different crops were on a higher side. Present estimates are based on average situation of the farm, which is likely to differ from an assumed farm model. Moreover, the number of estimated beneficiaries is also on the lower side as compared to PIP projections. Even then an ERR of 20% can be treated as satisfactory from economic point of view as it is much higher than the social rate of discount of 12%. On the other hand, our estimate of ERR for rural roads is much higher than pre-project estimate. This reflects the much higher flow of motorized traffic on project roads revealed in the 2004 traffic survey as compared to the traffic flow figures used in PIP studies. In last few years motorized traffic has increased at a phenomenal pace in the country including the rural areas. Hence, the higher value of ERR for rural roads calculated by us does not seem to be unexpected.

Table 5: Pre and Post Project Estimated ERR of DASP

Sector	Pre-Project Estimate	Post- Project Estimate
Agriculture	49.00	20.03
Animal Husbandry	26.00	25.41
Rural Roads	14.00	36.83
Overall Project	22.00	24.0

## **Conclusion**

40. In conclusion it may be said that our analysis indicates that the project is economically justifiable and financially viable for the farmers. The estimated ERR of 24% is fairly satisfactory and clearly above 12% social discount rate. NPV estimated at Rs. 5579 million is also high and justifies investment in the project. In addition to the measurable benefits included in our economic analysis, there are many other economic and social benefits of the project like higher employment levels, poverty reduction, environmental improvement, etc. which further strengthen the justification of investment in the project. Continuation of the project activities would, therefore, be desirable from economic and social point of view.

## ECONOMIC ANALYSIS: AGRICULTURE SECTOR

### Introduction

1. Project activities under agriculture sector aimed at technological up gradation through training of key staff, provision of high quality planting material, improvement in post-harvest technology. It laid emphasis on changes in the cropping pattern by introducing shift to high value added crops, use of integrated pest management technology and bio-fertilizers, etc. The project proposal was based on represented farm models for different regions. The farm models included following representative crops: wheat, paddy, sorghum, mango, oilseeds, potato, moong, chickpea, citrus and soyabean. The model envisaged typical increases in yield levels between 20% and 40% for different crops over a five year period from first adoption of full package. The major traded inputs such as fertilizer and traded commodities (wheat and rice) were priced at estimated border prices using World Bank Economic values for the non-traded component of project costs were estimated using a standard conversion factor of 0.9. Financial base costs were expressed in 1997 prices. The economic rate of return for agriculture (with horticulture) was estimated at 49%.

### Use of Prices

2. The present exercise broadly follows the above methodology suitably modified according to data availability. The financial base costs and outputs have been calculated at 2003 prices. Border prices for fertilizer, wheat and paddy were calculated using the same methodology and ratios used in the PIP study to arrive at economic farm gate prices under importable hypothesis. The correction factor was calculated at 1.32 for fertilizer (weighted average of urea and DAP prices with weights of 75% and 25% respectively), 1.64 for wheat and 1.35 for paddy. Details of calculations are given in Table 1. For other input costs and output prices a correction factor of 0.9 has been used as in the original study.

### **Data Source**

3. The calculations cover the six major representative crops, e.g. wheat, paddy, maize, arhar, mustard and vegetables (including potato). These were the main intervention crops under the project for which farm models were used by PIP. These crops cover 65 to 70 percent of gross cropped area. Fruit crops were excluded for want of detailed cost and output data. The data base for the analysis were provided by AMC, IIM, which carried out a survey of 497 farm households in the project districts spread over 84 villages in 42 blocks from 14 districts from different regions of the State. Out of this the sample covered from project area was 333 households from 56 villages in 28 project blocks and the sample covered from non-project area was 164 of households from 28 villages in 14 blocks. The survey collected data on output and input costs for major crops from the sample households.

### **Calculation of Net Benefits**

4. Since data on different types of farm models used in PIP were not available an average farm model for project area has been built up to calculate benefit of agriculture/horticulture component of the project. Net benefits from agriculture component have been computed as follows.

First, the financial values of costs and output for selected crops have been converted into economic prices by using the correction factors derived as above. Crop wise details of financial and economic analysis are given in Tables 2 (a) to 2 (f).

Secondly, crop-wise net income per ha. in project and non-project area has been calculated from AMC survey 2003. Net income on non-project farms in 2003 survey has been taken corresponding to baseline situation in the project area since cost and output data for base year were not available. The situation in non-project area is taken to represent the impact of the ongoing agricultural programmes. The assumption is that the difference in project and non-project situation captures the net impact of the project activities. The difference has been spread over five years using constant amount of change for each crop (Table 6 a). Per hectare net income for selected crops in the project area has been assumed to be constant over the project period (Table 6 b).

Thirdly, details of cropping pattern in project area and non-project area are taken from AMC Baseline (1998-99) and Impact III (2003-04) study. For intervening years percent area under each crop has been interpolated by adding one-fifth of total change in the intervening years under crop for the period 1998-99 to 2003-04 (Table 3 a and 3 b).

Fourthly, the cropping pattern as calculated above has been applied to the average holding size in U.P. The 1995-96 Agricultural Census shows the average size of operational holding in U.P. at 0.86 ha. and net sown area per holding is around 0.82 ha. This may have come down somewhat since then. Hence it is assumed that average net sown area per holding is 0.80 ha. Gross sown area on project and non-project area has been calculated by multiplying NSA by cropping intensity as reported in AMC impact study. By multiplying percent area under the selected crops by GSA under six crops we arrive at the actual area under these crops on the average farm in the project and the non-project area (Table 5 a and 5 b).

Fifthly, net income per ha. under each crop calculated above has been multiplied by calculated area under the crop for each year in the project and the non-project area. By adding up the net income from six selected crops we get total net income per farm for each year (Table 7 and 7 ii). The difference in the net income per farm in the project and non-project area gives net incremental income per farm as a result of the project intervention.

### **Number of Beneficiaries**

5. Next step is to calculate the number of beneficiaries who have benefited from the project activities. The Project Implementation Report had assumed that around 5% of farmers in the project area, that is around 95,000 farmers, will adopt improved practices by the fifth year. The PCU has reported the number of farmers covered under various agricultural activities like IPNM, IPM, training, etc. at 228000. AMC Impact Survey III shows the level of adoption of various type of improved practices of agriculture and horticulture in the project area as follows:

Type of Practice	Per Cent of Farmers Adopting
NADEP	39
Vermicompost	19
CPP	19
Rhizobium	24
Azotobacter	10
Neem Oilcake	29
Tricoderma	19
Tricogamma	7
Low Poly tunnel	16
Bed Planter	12
Average Ag & Hort	19.4

On the basis of the adoption rates reported for various activities by AMC broadly the proportion of farmers adopting a package of improved practices can be put at 19.5% of beneficiaries covered or around 45,000. These are direct beneficiaries who have adopted the package of multiple improved practices propagated under the project and hence are assumed to have gained the full benefits. In addition, there is likely to be spill over affect on other farmers in the project area through demonstration affect. However, their numbers cannot be easily estimated nor the impact of adoption on income levels can be properly assessed. Hence, such spill-over effects have been ignored as done in the PIP study.

#### **Calculation of ERR**

6. By multiplying the net incremental benefit per farm as calculated above by the number of farmers adopting improved practices, stream of net returns over 20 years is arrived at. Overhead costs include the expenditure on agriculture and horticulture component as well as research, marketing support, etc. for different years as reported by PCU. These costs have been converted into 2003 prices on the basis of the index of wholesale prices in the country. The updated costs have been adjusted by a factor of 0.9 to correspond to border prices.

7. ERR calculated for agriculture including vegetable cultivation (but excluding fruit crops) comes to 20% assuming 19.5% adoption rate (Table 8). This compares with the estimated ERR of agriculture (with horticulture) of 49% in the PIP Report derived from



farm models. Our ERR also excludes benefit from fruit crops like mango and apple, under which there has been substantial expansion in area during the project period. In addition, several other value addition activities have been carried out like seed production, etc. If benefits from these activities are taken into account the ERR will be higher.

8. Since the nature of project activities are mainly in terms of dissemination of knowledge about improved cultural practices the costs tend to be low and benefits high. In fact, capturing direct benefits of such interventions is extremely difficult. Moreover, the improvement in yield levels and changes in cropping pattern are affected by a number of other factors, such as, the ongoing government programmes, improvement in irrigation and road infrastructure, as well as market prices. Hence, the entire reported benefits can not be attributed to project activities alone. Nevertheless, the calculated ERR provide ample justification of the project costs in terms of net economic benefits.

#### **Financial Analysis Crop Sector**

9. Financial analysis for the crop sector has been done using the cost and output data for six intervention crops (paddy, wheat, maize, arhar, mustard and vegetables) from AMC Survey. Farm gate prices have been used both for inputs and outputs. Net incremental gains represent benefits from changes in the cropping pattern and the increase in yields due to project intervention as well as change in input structure. The values reported for non-project area has been assumed to represent base year situation. 20 per cent of total gains have been uniformly spread over five years. By applying values of costs and outputs per hectare to actual area under crop on an average model farm of 0.8 hectare. Results are shown in Table 9.

10. The base year net income taken at Rs. 11,768 rises to Rs.19, 614 in the fifth year in the project area and to Rs. 12,972 in the non-project area (due to changes in cropping pattern). Net incremental income rises from Rs. 1166 in the base year to Rs. 6642 in the fifth year and then is assumed to be constant. NPV comes to Rs.34, 232. Thus a shift in cropping pattern and higher yields due to improved practices promoted by project intervention lead to an increase of over 50% on an average farm of 0.80 hectare.



## Seed Component

11. Seed cultivation has been promoted as one of the components of the project activities. By 2002-03, an area of 4037 ha has been brought under seed cultivation, mainly under wheat, rice, pulses and oilseeds. Seed cultivation creates value addition as the price for good quality seed is higher than the price of normal quality grains/other output. Gross additional gain from seed cultivation is calculated as the difference between the gross value of sale of seed output at market prices and the gross value of output of normal produce at MSP (Minimum Support Price), which is lower than market price of good quality seed. From the gross gain additional price paid for improved seed has been deducted to arrive at the net gain per hectare from seed cultivation, which is over and above the net gains from cultivation of normal crop. Other costs are assumed to be same in both situations.

12. Data on area under seeds and net gains from seed cultivation have been supplied by the Project Coordination Unit (Tables 10 and 11). By dividing total additional income from seed cultivation by area under improved seed under each crop we get per hectare net gain from seed cultivation (Table 12). By multiplying per ha additional income from seed cultivation by area under different crops on an average farm we get net additional income from seed cultivation on an average farm (Table 13). The net gain per farm amounts to Rs. 4549 in 2003-04. This is the additional income that an average farmer in the project area can obtain if he devotes entire area under the selected crops for cultivation of improved seeds over and above what he would get from cultivation of normal crop.

## Mango Component

13. Economic analysis of fruit crops could not be done due to lack of data on output and cost items of different types of crops. An illustrative case of mango, the main fruit crop of U.P. plains has been worked out on the basis of cost and yield data supplied by Directorate of Horticulture U.P. (Table 14 and 15). Mango plant starts giving fruits from the fifth year. Productivity is assumed to rise up to the tenth year and then held constant. Net incremental income from mango cultivation has been computed by taking the

difference between net income from mango and net income from subsistence crops. Mango cultivation yields a net income of Rs. 40,000 per hectare against a net income of Rs. 8200 per hectare from subsistence crops as reported by AMC survey). Thus by switching over from current subsistence crops to mango cultivation a farmer can earn a net incremental income of Rs. 32,000 from tenth years onward (Table 16). ERR of mango cultivation comes to 30% to individual farmers over a 20 year span.

14. Detailed calculations have been reproduced in accompanying tables.

Table 1: Parity Price Calculation used in the Present Study (Per Tonne)

Items	Urea	DAP	Rice	Wheat
World Market Price 2003 US\$				
Quality Adjustment (%)				
Equivalent Price US \$			178	142.4
Ocean Freight US\$			50	55
CIF Mumbai US\$	140	180	228	197.4
Exchange Rate Rs/\$	46	46	46	46
CIF Mumbai Rs.	6440	8280	10488	9080
Add Port Charges and Transport/marketing Rs.	557	658	901	1081
Sub Total	6997	8938	11389	10161
Processing Adjustment				
Processing Costs				
Bye product Value				
Value at Processor	6997	8938	7457	9653
Transport to processor/marketing				
Economic Farm Gate Price	7131	9096	7671	9869
Financial Farm Gate Price Used in Farm Model	4926	9537	5700	6000
Economic Price Adjustment Factor	1.45	0.95	1.35	1.64

Note: Same ratios have been used for transport, processing cost, etc. as in the PIP Report Vol. IV.

Table 2: Financial and Economic Analysis of Crops

Table 2 a i						
Paddy: Financial Analysis						
Items	1998-99	1999-00	2000-01	2001-02	2002-03	2002-03
Fertilizer	2347	2247.2	2147.4	2047.6	1947.8	1848
Bullock Labour	786	732	678	624	570	516
Irrigation	1805	1810	1815	1820	1825	1830
Seed	580	576.6	573.2	569.8	566.4	563
Manure	683	730.4	777.8	825.2	872.6	920
Plant Protection	972	873.2	774.4	675.6	576.8	478
Hired Labour	2338	2247.2	2156.4	2065.6	1974.8	1884
Machine Cost	1377	1520.6	1664.2	1807.8	1951.4	2095
Total Cost	10888	10735.2	10582.4	10429.6	10276.8	10124
Production Qtls.	26	26.4	26.8	27.2	27.6	28
Price	570	570	570	570	570	570
Value of Produce	14820	15048	15276	15504	15732	15960
Value of Bye Product	2408	2454.2	2500.4	2546.6	2592.8	2639
Total Income	17228	17502.2	17776.4	18050.6	18324.8	18599
Net Income	6340	6767	7194	7621	8048	8475

Source: AMC Survey

Table 2 a ii						
Paddy : Economic Analysis						
Items	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Fertiliser	3098.04	2966.304	2834.568	2702.832	2571.096	2439.36
Bullock Labour	707.4	658.8	610.2	561.6	513	464.4
Irrigation	1624.5	1629	1633.5	1638	1642.5	1647
Seed	522	518.94	515.88	512.82	509.76	506.7
Manure	614.7	657.36	700.02	742.68	785.34	828
Plant Protection	874.8	785.88	696.96	608.04	519.12	430.2
Hired Labour	2104.2	2022.48	1940.76	1859.04	1777.32	1695.6
Machine Cost	1239.3	1368.54	1497.78	1627.02	1756.26	1885.5
Total Cost	10784.94	10607.3	10429.67	10252.03	10074.4	9896.76
Production Qtls.	26	26	26	26	26	28
Price	769.5	769.5	769.5	769.5	769.5	769.5
Value of Produce	20007	20007	20007	20007	20007	21546
Value of Bye Product	2408	2454	2500	2546	2592	2639
Total Income	22415	22461	22507	22553	22599	24185
Net Income	11630	11853	12077	12301	12525	14288

Table 2 b i						
Wheat : Financial Analysis						
Items	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Fertilizer	2875	2805.4	2735.8	2666.2	2596.6	2527
Bullock Labour	681	646.8	612.6	578.4	544.2	510
Irrigation	2191	2132.4	2073.8	2015.2	1956.6	1898
Seed	1350	1306.4	1262.8	1219.2	1175.6	1132
Manure	654	689.6	725.2	760.8	796.4	832
Plant Protection	409	392	375	358	341	324
Hired Labour	2058	2041.4	2024.8	2008.2	1991.6	1975
Machine Cost	2821	2823	2825	2827	2829	2831
Total Cost	13038	10031.6	9899.2	9766.8	9634.4	9502
Production Qtls.	30	30.6	31.2	31.8	32.4	33
Price	600	600	600	600	600	600
Value of Produce	18000	18360	18720	19080	19440	19800
Value of Bye Product	4854	4915	4976	5037	5098	5159
Total Income	22854	23275	23696	24117	24538	24960
Net Income	9816	13243.4	13796.8	14350.2	14903.6	15458

Source: AMC Survey

Table 2 b ii						
Wheat : Economic Analysis						
Items	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Fertilizer	3795	3703.128	3611.256	3519.384	3427.512	3335.64
Bullock Labour	612.9	582.12	551.34	520.56	489.78	459
Irrigation	1971.9	1919.16	1866.42	1813.68	1760.94	1708.2
Seed	1215	1175.76	1136.52	1097.28	1058.04	1018.8
Manure	588.6	620.64	652.68	684.72	716.76	748.8
Plant Protection	368.1	352.8	337.5	322.2	306.9	291.6
Hired Labour	1852.2	1837.26	1822.32	1807.38	1792.44	1777.5
Machine Cost	2538.9	2540.7	2542.5	2544.3	2546.1	2547.9
Total Cost	12942.6	12731.57	12520.54	12309.5	12098.47	11887.44
Production Qtls.	30	30.6	31.2	31.8	32.4	33
Price	984	984	984	984	984	984
Value of Produce	29520	30110.4	30700.8	31291.2	31881.6	32472
Value of Bye Product	4854	4915	4976	5037	5098	5159
Total Income	34374	35025	35676	36328	36979	37631
Net Income	21431	22293	23156	24018	24881	25743

Table 2 c i						
Maize: Financial Analysis						
Items	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Cost of Fertilizer	1115	1103.6	1092.2	1080.8	1069.4	1058
Cost of bullock labour	455	435.4	415.8	396.2	376.6	357
Irrigation cost	517	532.8	548.6	564.4	580.2	596
Seed cost	719	721.6	724.2	726.8	729.4	732
Organic manure	263	283.8	304.6	325.4	346.2	367
Plant protection measure	116	116.2	116.4	116.6	116.8	117
Hired labour	1854	1792	1730	1668	1606	1544
Machine cost	1678	1662	1646	1630	1614	1598
Total expenditure	6717	6647.4	6577.8	6508.2	6438.6	6369
Total Production (Qtl)	18	18.4	18.8	19.2	19.6	20
Sale Price (Rs./qtl)	450	450	450	450	450	450
Value of produce	8100	8280	8460	8640	8820	9000
Total by-product value	880	903.4	926.8	950.2	973.6	997
Gross Income	8980	9183.4	9386.8	9590.2	9793.6	9997
Net income	2263	2536	2809	3082	3355	3628

Source: AMC Survey

Table 2 c ii						
Economic Analysis: Maize						
Items	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Cost of Fertilizer	1471.8	1456.75	1441.70	1426.65	1411.60	1396.56
Cost of bullock labour	409.5	391.86	374.22	356.58	338.94	321.3
Irrigation cost	465.3	479.52	493.74	507.96	522.18	536.4
Seed cost	647.1	649.44	651.78	654.12	656.46	658.8
Organic manure	236.7	255.42	274.14	292.86	311.58	330.3
Plant protection measure	104.4	104.58	104.76	104.94	105.12	105.3
Hired labour	1668.6	1612.8	1557	1501.2	1445.4	1389.6
Machine cost	1510.2	1495.8	1481.4	1467	1452.6	1438.2
Total expenditure	6513.6	6446.17	6378.74	6311.31	6243.88	6176.46
Total Production (Qtl)	18	18.4	18.8	19.2	19.6	20
Sale Price (Rs./qtl)	450	450	450	450	450	450
Value of produce	7290.00	7452.00	7614.00	7776.00	7938.00	8100.00
Total by-product value	792.00	813.06	834.12	855.18	876.24	897.30
Gross Income	8082.00	8265.06	8448.12	8631.18	8814.24	8997.30
Net income	1568.40	1818.89	2069.38	2319.86	2570.35	2820.84



Table 2 d i						
Arhar: Financial Analysis						
Item	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Cost of Fertilizer	548	499.2	450.4	401.6	352.8	304
Cost of bullock labour	785	742.8	700.6	658.4	616.2	574
Irrigation cost	120	110	100	90	80	70
Seed cost	728	730.6	733.2	735.8	738.4	741
Organic manure	40	61	82	103	124	145
Plant protection measure	334	294.4	254.8	215.2	175.6	136
Hired labour	986	1002	1018	1034	1050	1066
Machine cost	886	957.6	1029.2	1100.8	1172.4	1244
Total expenditure	4427	4397.6	4368.2	4338.8	4309.4	4280
Total Production (Qtl)	13	13.2	13.4	13.6	13.8	14
Sale Price (Rs./qtl)	1600	1600	1600	1600	1600	1600
Value of produce	20800	21120	21440	21760	22080	22400
Total by-product value	1618	1629.2	1640.4	1651.6	1662.8	1674
Gross Income	22418	22749.2	23080.4	23411.6	23742.8	24074
Net income	17991	18351.6	18712.2	19072.8	19433.4	19794

Source: AMC Survey

Table 2 d ii						
Arhar: Economic Analysis						
Items	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Cost of Fertilizer	723.36	658.94	594.52	530.11	465.69	401.28
Cost of bullock labour	706.5	668.52	630.54	592.56	554.58	516.6
Irrigation cost	108	99	90	81	72	63
Seed cost	655.2	657.54	659.88	662.22	664.56	666.9
Organic manure	36	54.9	73.8	92.7	111.6	130.5
Plant protection measure	300.6	264.96	229.32	193.68	158.04	122.4
Hired labour	887.4	901.8	916.2	930.6	945	959.4
Machine cost	797.4	861.84	926.28	990.72	1055.16	1119.6
Total expenditure	4214.46	4167.50	4120.54	4073.59	4026.63	3979.68
Total Production (Qtl)	13	13.2	13.4	13.6	13.8	14
Sale Price (Rs./qtl)	1600	1600	1600	1600	1600	1600
Value of produce	18720.00	19008.00	19296.00	19584.00	19872.00	20160.00
Total by-product value	1456.20	1466.28	1476.36	1486.44	1496.52	1506.60
Gross Income	20176.20	20474.28	20772.36	21070.44	21368.52	21666.60
Net income	15961.74	16306.78	16651.81	16996.85	17341.88	17686.92

Table 2 e i						
Mustard: Financial Analysis						
Items	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Cost of Fertilizer	905	899	893	8872	881	875
Cost of bullock labour	455	454	453	453	452	451
Irrigation cost	1393	1363	1333	1304	1274	1245
Seed cost	215	212	209	206	203	200
Organic manure	138.33	131.80	125.27	118.74	112.20	105.67
Plant protection measure	82.86	80.98	79.10	77.22	75.34	73.46
Hired labour	1245	1208.52	1172.04	1135.55	1099.07	1062.59
Machine cost	2215	2242	2269	2296	2323	2350
Total expenditure	6649.48	6592.32	6535.17	6478.02	6420.87	6363.71
Total Production (Qtl)	10.19	10.35	10.51	10.67	10.83	10.99
Sale Price (Rs./qtl)	1650	1650	1650	1650	1650	1650
Value of produce	16813.5	17079.6	17345.7	17611.8	17877.9	18144
Total by-product value	0	0	0	0	0	0
Gross Income	16813.5	17079.6	17345.7	17611.8	17877.9	18144
Net income	10164.02	10487.28	10810.53	11133.78	11457.03	11780.29

Source: AMC Survey

Table 2 e ii						
Economic Analysis: Mustard						
Items	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Cost of Fertilizer	1194.66	1186.73	1178.79	1170.86	1162.93	1155.00
Cost of bullock labour	409.5	408.95	408.41	407.87	407.33	406.79
Irrigation cost	1253.91	1227.23	1200.54	1173.86	1147.18	1120.5
Seed cost	193.5	190.8	188.1	185.4	182.7	180
Organic manure	124.5	118.62	112.74	106.86	100.98	95.10
Plant protection measure	74.57	72.87	71.18	69.49	67.80	66.11
Hired labour	1120.5	1087.66	1054.83	1021.99	989.16	956.33
Machine cost	1993.5	2017.8	2042.1	2066.4	2090.7	2115
Total expenditure	6364.64	6310.68	6256.72	6202.76	6148.80	6094.84
Total Production (Qtl)	10.19	10.35	10.51	10.67	10.83	10.99
Sale Price (Rs./qtl)	1650	1650	1650	1650	1650	1650
Value of produce	15132.15	15371.64	15611.13	15850.62	16090.11	16329.60
Total by-product value	0.00	0.00	0.00	0.00	0.00	0.00
Gross Income	15132.15	15371.64	15611.13	15850.62	16090.11	16329.60
Net income	8767.50	9060.95	9354.40	9647.86	9941.31	10234.76



Table 2 f i						
Vegetables: Financial Analysis						
Item	1998-99	1999-00	2000-01	2001-02	2002-3	2003-04
Fertilizer	572.77	598.38	623.99	649.60	675.20	700.81
Bullock Labour	2830.03	2950.59	3071.15	3191.70	3312.26	3432.82
Irrigation	6637.84	6706.48	6775.12	6843.76	6912.40	6981.05
Seed	5189.57	4914.65	4639.72	4364.79	4089.86	3814.93
Manure	612.77	733.39	854.01	974.62	1095.24	1215.85
Plant Protection	595.15	642.30	689.45	736.60	783.74	830.89
Hired Labour	3491.59	3580.79	3670.00	3759.21	3848.42	3937.63
Machine Cost	2340.18	2425.25	2510.32	2595.39	2680.46	2765.53
Total Cost	22269.91	22551.83	22833.75	23115.68	23397.60	23679.52
Production Qtls.						
Price						
Value of Produce	63939.02	65423.38	66907.73	68392.08	69876.43	71360.78
Value of Bye Product						
Total Income	63939.02	65423.38	66907.73	68392.08	69876.43	71360.78
Net Income	41669.12	42871.54	44073.97	45276.4	46478.83	47681.26

Source: AMC Survey

Table 2 f ii						
Vegetables: Economic Analysis						
Item	1998-99	1999-00	2000-01	2001-02	2002-3	2003-04
Fertiliser	756	789	823	857	891	925
Bullock Labqur	2547	2655	2764	2872	2981	3089
irrigation	5974	6035	6097	6159	6221	6282
Seed	4670	4423	4175	3928	3680	3433
Manure	551	660	768	877	985	1094
Plant Protection	535	578	620	662	705	747
Hired Labour	3142	3222	3303	3383	3463	3543
Machine Cost	2106	2182	2259	2335	2412	2488
Total Cost	20283	20547	20812	21076	21341	21605
Production Qtls.						
Price						
Value of Produce	57545	58881	60217	61553	62889	64225
Value of Bye Product	0	0	0	0	0	0
Total Income	57545	58881	60217	61553	62889	64225
Net Income	37262	38333	39404	40476	41547	42619

Table 3 (a) Percent Area under Crop to GSA: Project Area

Crops/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-4
Paddy	20.6	19.36	18.12	16.88	15.64	14.4
Wheat	34.1	32.96	31.82	30.68	29.54	28.4
Coarse Cereals	12.4	12.4	12.4	12.4	12.4	12.4
Total Cereals	67.2	64.82	62.44	60.06	57.68	55.3
Pulses	7.1	8.42	9.74	11.06	12.38	13.7
Total Foodgrains	74.3	73.24	72.18	71.12	70.06	69
Sugarcane	6.5	6.78	7.06	7.34	7.62	7.9
Oilseeds	3.9	3.9	3.9	3.9	3.9	3.9
Vegetables	8.4	9.36	10.32	11.28	12.24	13.2
Fruits	4.5	4.02	3.54	3.06	2.58	2.1
Spices	0.3	0.4	0.5	0.6	0.7	0.8
Flowers	0.4	0.38	0.36	0.34	0.32	0.3
Other Crops	1.7	1.9	2.1	2.3	2.5	2.7
Total Non-Foodgrains	25.7	26.76	27.82	28.88	29.94	31
All Crops	100	100	100	100	100	100
Cropping Intensity	169	175.8	182.6	189.4	196.2	203
Net Sown Area ha. per farm	1.36	1.36	1.36	1.36	1.36	1.36
Gross Cropped Area per farm	2.30	2.39	2.48	2.58	2.67	2.76

Source: AMC Survey

Table 3 (b): Percent Area under Crop to GSA: Non-Project Area

Crops/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-4
Paddy	20.6	20.16	19.72	19.28	18.84	18.4
Wheat	34.1	33.54	32.98	32.42	31.86	31.3
Coarse Cereals	12.4	12	11.6	11.2	10.8	10.4
Total Cereals	67.2	65.78	64.36	62.94	61.52	60.1
Pulses	7.1	7.76	8.42	9.08	9.74	10.4
Total Foodgrains	74.3	73.54	72.78	72.02	71.26	70.5
Sugarcane	6.5	7.54	8.58	9.62	10.66	11.7
Oilseeds	3.9	3.84	3.78	3.72	3.66	3.6
Vegetables	8.4	8.36	8.32	8.28	8.24	8.2
Fruits	4.5	4.2	3.9	3.6	3.3	3
Spices	0.3	0.3	0.3	0.3	0.3	0.3
Flowers	0.4	0.34	0.28	0.22	0.16	0.1
Other Crops	1.7	1.92	2.14	2.36	2.58	2.8
Total Non-Foodgrains	25.7	26.48	27.26	28.04	28.82	29.6
All Crops	100	100	100	100	100	100
Cropping Intensity	169	174.4	179.8	185.2	190.6	196
Net Sown Area ha. per farm	1.15	1.15	1.15	1.15	1.15	1.15
Gross Cropped Area per farm	1.9435	2.0056	2.0677	2.1298	2.1919	2.254

Source: AMC Survey

Table 4 (a)(i) : Percent Area Under Six Selected Crops to GSA: Project Area

Crops/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Paddy	20.6	19.36	18.12	16.88	15.64	14.4
Wheat	34.1	32.96	31.82	30.68	29.54	28.4
Maize	4.96	4.96	4.96	4.96	4.96	4.96
Arhar	1.07	1.26	1.46	1.66	1.86	2.06
Mustard	2.57	2.57	2.57	2.57	2.57	2.57
Vegetables	8.4	9.36	10.32	11.28	12.24	13.2
Total 6 Crops	71.70	70.48	69.26	68.03	66.81	65.59
All Crops	100	100	100	100	100	100

Source: AMC Survey

Table 4 (a)(ii): Percent Area Under Crop to Total Area under Six Selected Crops: Project Area

Crops/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Paddy	28.73	27.47	26.16	24.81	23.41	21.95
Wheat	47.56	46.77	45.95	45.10	44.21	43.30
Maize	6.92	7.04	7.16	7.29	7.42	7.56
Arhar	1.49	1.79	2.11	2.44	2.78	3.13
Mustard	3.59	3.65	3.72	3.78	3.85	3.92
Vegetables	11.72	13.28	14.90	16.58	18.32	20.13
Total 6 Crops	100	100	100	100	100	100

Table 4 (b)(i) : Percent Area Under Six Selected Crops to GSA: Project Area

Crops/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Paddy	20.6	20.16	19.72	19.28	18.84	18.4
Wheat	34.1	33.54	32.98	32.42	31.86	31.3
Maize	4.96	4.8	4.64	4.48	4.32	4.16
Arhar	1.07	1.16	1.26	1.36	1.46	1.56
Mustard	2.57	2.53	2.49	2.46	2.42	2.38
Vegetables	8.4	8.36	8.32	8.28	8.24	8.2
Total 6 Crops	71.70	70.56	69.42	68.28	67.14	66.00
All Crops	100	100	100	100	100	100

Source: AMC Survey

Table 4 (b)(ii): Percent Area Under Crop to Total Area under Six Selected Crops: Project Area

Crops/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Paddy	28.73	28.57	28.41	28.24	28.06	27.88
Wheat	47.56	47.54	47.51	47.48	47.46	47.43
Maize	6.92	6.80	6.68	6.56	6.43	6.30
Arhar	1.49	1.65	1.82	1.99	2.18	2.36
Mustard	3.59	3.59	3.59	3.60	3.60	3.60
Vegetables	11.72	11.85	11.99	12.13	12.27	12.42
Total 6 Crops	100	100	100	100	100	100

Table 5 (a) (i): Net and Gross Sown Area on Average Holding: Project Area

Item	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Net Sown Area on Average Holding in U.P. in ha.	0.8	0.8	0.8	0.8	0.8	0.8
Cropping Intensity	169	175.8	182.6	189.4	196.2	203
GSA Project Area in ha.	1.35	1.41	1.46	1.52	1.57	1.62
Area under 6 crops in ha.	0.97	0.99	1.01	1.03	1.05	1.07

Source: Agricultural Census of U.P., 1995-96 and AMC Survey

Table 5(a)(ii): Actual Area on Average Farm Under Six Crops: Project Area (in ha.)

Crops/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Paddy	0.2785	0.2723	0.2647	0.2558	0.2455	0.2339
Wheat	0.4610	0.4635	0.4648	0.4649	0.4637	0.4612
Maize	0.0671	0.0698	0.0725	0.0752	0.0779	0.0806
Arhar	0.0144	0.0178	0.0213	0.0251	0.0291	0.0334
Mustard	0.0348	0.0362	0.0376	0.0390	0.0404	0.0418
Vegetables	0.1136	0.1316	0.1508	0.1709	0.1921	0.2144
Total 6 Crops	0.9694	0.9912	1.0117	1.0308	1.0487	1.0652

Table 5 (b) (i): Net and Gross Sown Area on Average Holding: Non-Project Area

Item	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Net Sown Area on Average Holding in U.P. in ha.	0.8	0.8	0.8	0.8	0.8	0.8
Cropping Intensity	169	174.4	179.8	185.2	190.6	196
GSA Project Area in ha.	1.352	1.3952	1.4384	1.4816	1.5248	1.568
Area under 6 crops in ha.	0.9694	0.9844	0.9985	1.0116	1.0237	1.0348

Source: Agricultural Census of U.P., 1995-96 and AMC Survey

Table 5(b)(ii): Actual Area on Average Farm Under Six Crops: Non- Project Area (in ha.)

Crops/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Paddy	0.2785	0.2813	0.2837	0.2857	0.2873	0.2885
Wheat	0.4610	0.4680	0.4744	0.4803	0.4858	0.4908
Maize	0.0671	0.0670	0.0667	0.0664	0.0659	0.0652
Arhar	0.0144	0.0162	0.0182	0.0202	0.0223	0.0245
Mustard	0.0348	0.0354	0.0359	0.0364	0.0368	0.0373
Vegetables	0.1136	0.1166	0.1197	0.1227	0.1256	0.1286
Total 6 Crops	0.9694	0.9844	0.9985	1.0116	1.0237	1.0348

Table 6 (i): Net Income Per Ha. : Project Area (in Rs.)

Crop/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Paddy	11630	11854	12078	12302	12525	14288
Wheat	21431	22294	23156	24019	24881	25744
Maize	1568	1819	2069	2320	2570	2821
Arhar	15962	16307	16652	16997	17342	17687
Mustard	8768	9061	9354	9648	9941	10235
Vegetables	37262	38333	39404	40476	41547	42619

Source: AMC Survey, 2003

Table 6 (ii): Net Income Per Ha. : Non-Project Area (in Rs.)

Crop/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Paddy	11630	11630	11630	11630	11630	11630
Wheat	21431	21431	21431	21431	21431	21431
Maize	1568	1568	1568	1568	1568	1568
Arhar	15962	15962	15962	15962	15962	15962
Mustard	8768	8768	8768	8768	8768	8768
Vegetables	37262	37262	37262	37262	37262	37262

Source: AMC Survey, 2003

Table 7 (i): Net Income Per Farm in Rs.: Project Area

Crops/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Paddy	3239	3228	3197	3146	3075	3341
Wheat	9881	10334	10764	11165	11536	11873
Maize	105	127	150	174	200	227
Arhar	230	290	355	427	505	590
Mustard	305	328	352	376	402	428
Vegetables	4232	5046	5940	6918	7982	9136
Total	17992	19353	20758	22208	23700	25596

Table 7 (ii): Net Income Per Farm in Rs.: Non- Project Area

Crops/Year	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Paddy	3239	3271	3299	3322	3341	3355
Wheat	9881	10029	10167	10294	10411	10518
Maize	105	105	105	104	103	102
Arhar	230	259	290	322	356	390
Mustard	305	310	315	319	323	327
Vegetables	4232	4346	4459	4571	4682	4791
Total	17992	18320	18634	18933	19216	19484
Net Incremental Income Per Farm (Rs.)	0	1032	2124	3275	4485	6112

Table 8: Net Incremental Income Stream and ERR Agriculture Sector

Year	No. of Beneficiaries	Net Incremental Income in Rs. Mn.	Project Overhead Cost in Rs. Mn.	Net Benefit Stream In Rs. Mn.
1		0	6.20	-6.20
2	9000	9.28	55.90	-46.61
3	18000	28.40	120.05	-91.64
4	27000	57.87	207.52	-149.64
5	38000	98.23	347.28	-249.05
6	45000	153.24	425.03	-271.78
7	45000	198.96	42.50	156.46
8	45000	234.86	42.50	192.36
9	45000	260.40	42.50	217.90
10	45000	275.05	42.50	232.55
11	45000	275.05		275.05
12	45000	275.05		275.05
13	45000	275.05		275.05
14	45000	275.05		275.05
15	45000	275.05		275.05
16	45000	275.05		275.05
17	45000	275.05		275.05
18	45000	275.05		275.05
19	45000	275.05		275.05
20	45000	275.05		275.05
ERR		20.03%		
NPV Rs. Mn.		320.26		



Table 9: Financial Flow Crop Sector on 0.80 Hectare Average Farm Model

Cash Flow: Project Area						
Items/Year	0	1	2	3	4	5
Fertiliser	2158	2109	2056	2000	1941	1880
Bullock Labour	912	947	989	1038	1094	1159
Irrigation	2352	2452	2557	2668	2782	2902
Seed	1440	1480	1514	1540	1556	1564
Manure	584	641	700	763	829	898
Plant Protection	542	520	500	482	468	456
Hired Labour	2173	2216	2256	2300	2347	2400
Machine Cost	2152	2256	2358	2460	2559	2657
Total Cost	12318	12621	12930	13249	13574	13914
Value of Produce	21116	22786	24549	26407	28350	30395
Value of Bye Product	2991	3038	3077	3106	3124	3133
Total Income	24107	25825	27626	29513	31474	33528
Net Income	11788	13204	14696	16264	17900	19614
Cash Flow: Non-Project Area						
Items/Year	0	1	2	3	4	5
Fertiliser	2158	2188	2215	2239	2262	2282
Bullock Labour	912	929	946	961	976	991
Irrigation	2352	2393	2433	2470	2505	2538
Seed	1440	1468	1495	1521	1546	1570
Manure	584	593	601	608	614	620
Plant Protection	542	550	558	565	571	577
Hired Labour	2178	2212	2244	2273	2300	2325
Machine Cost	2152	2185	2217	2245	2272	2296
Total Cost	12319	12518	12708	12881	13046	13199
Value of Produce	21117	21522	21919	22291	22650	22997
Value of Bye Product	2991	3034	3074	3110	3144	3174
Total Income	24108	24556	24993	25401	25793	26171
Net Income	11788	12038	12285	12520	12748	12972
Net Incremental Income Rs.	0	1166	2410	3744	5152	6642
NPV Rs. 34232						

Source: Based on AMC Survey.

Note: 1. Net incremental income represents gain from changes in the cropping pattern and increased productivity due to project intervention.

2. Analysis is on the basis of farm gate prices of inputs and outputs.

3. Net cash flow assumed to be constant from year 5 to year 20.

Table 10: Total Area under Seeds in Ha. In Project Area

Crops	1999-00	2000-01	2001-02	2002-03	2003-04
Rice	38	60	300	910	625
Kharif Pulses	30	52	260	765	750
Kharif Oilseeds	12	22	89	312	321
Wheat	10	218	660	1050	
Rabi Pulses	0	145	550	600	
Rabi Oilseeds	0	110	270	400	
Total	90	607	1480	4037	1696

Source: Project data supplied by PCU, UP DASP

Table 11: Net Additional Profit from Seed Cultivation in Rs. (Total)

Crops	1999-00	2000-01	2001-02	2002-03	2003-04
Rice	271360	437200	1869700	4645700	5150000
Kharif Pulses	64550	118780	505000	284750	356250
Kharif Oilseeds	27680	38280	166390	425400	137760
Wheat	28000	770600	3348000	7161000	
Rabi Pulses		383250	1463500	1860000	
Rabi Oilseeds		159600	614100	1120600	
Total	391590	1907710	5425600	15497450	5644010

Source: Project data supplied by PCU, UP DASP

Table 12: Additional Profit Per Ha. from Seed Cultivation in Rs.

Crops	1999-00	2000-01	2001-02	2002-03	2003-04
Rice	7141	7287	6232	5105	8240
Kharif Pulses	2152	2284	1942	372	475
Kharif Oilseeds	2307	1740	1870	1363	429
Wheat	2800	3535	5073	6820	
Rabi Pulses		2643	2661	3100	
Rabi Oilseeds		1451	2274	2802	
Total	4351	3143	3666	3839	
Pulses Total	2151	2548	2430	1571	475
Oilseeds Total	2307	1499	2174	2171	429

Source: Calculated from Table 1 and Table 2.

Table 13: Additional Income from Seed Cultivation per Farm in Rs.

Crops	1999-00	2000-01	2001-02	2002-03
Paddy	1944	1929	1594	1253
Wheat	1298	1643	2358	3162
Pulses	38	54	61	46
Oilseeds	84	56	85	88
Total	3364	3683	4098	4549

Assumption: All area under crop is used for improved seed cultivation. Additional income is what farmer would get over net income from normal crop.

Table 14: One Hectare Mango Orchard: Financial Analysis (Costs)

SL. NO.	ITEM	YEAR WISE COST IN RUPEES					Total Cost
		1	2	3	4	5	
<b>A.</b>	<b>MATERIAL COST</b>						
1	Planting material =110 Plants @Rs.14.00 per plant	1540					1540
2	Manure (FYM) 50qtl. @ Rs.25/qtl	1250					
3	Fertilizers Cost						
i	Nitrogen	106	212	319	425	531	1593
ii	Phosphorus	76	152	228	304	380	1140
iii	Potash	71	142	213	284	355	1065
4	Plant Protection measures	500	550	600	650	700	3000
5	Fuel for irrigation	500	500	550	550	600	2700
6	Live Fencing	2000					2000
7	Garden Implements	300					300
8	Miscellaneous for grading, packing etc.					1000	1000
	Total Of A	6343	1556	1910	2213	3566	15588
<b>b</b>	<b>OPERATIONAL COST</b>						
1	Land Preparation	1000	500	500	500	500	3000
2	Digging and filling pits	1160					1160
3	Application of manures Fertilizers & pesticides	58	58	58	116	116	406
4	Planting	232					232
5	Preparation Of irrigation channels	290	290	290	290	290	1450
6	Intercultural Operation	290	290	290	290	290	1450
7	Live Fencing	580					580
8	Harvesting					290	290
	Total Of B	3610	1138	1138	1196	1486	8568
	GRAND TOTAL Of (A +B)	9953	2694	3048	5409	5052	24156

Source: Directorate of Horticulture, U.P.

Table 15: One Hectare Mango Orchard: Financial Analysis (Net Income)

Year	No. of Plants	Yield per plant in Kg. (5th year onwards)	Yield Per Ha. (in Kg.)	Rate Rs. /kg.	Income from main crop (Rs.)	Income from Inter-Cropping (Rs.)	Total Income (Rs.)	Maintenance Cost 6 <sup>th</sup> Year onwards	Net Income (Rs.)
1	100					5000	5000		-4953
2	100					4000	4000		1306
3	100					3000	3000		-48
4	100					2000	2000		-1409
5	100	10	1000	5	5000	1000	6000		948
6	100	25	2500	5	12500		12500	5000	7500
7	100	40	4000	5	20000		20000	5000	15000
8	100	50	5000	5	25000		25000	5000	20000
9	100	80	8000	5	40000		40000	5000	35000
10	100	90	9000	5	45000		45000	5000	40000

Source: Directorate of Horticulture, U.P.

Note: Net income assumed to be constant from 10<sup>th</sup> year to 20<sup>th</sup> year.

Table 16: Net Incremental Income Stream and ERR of One Hectare Mango Orchard

Year	Cost	Income Main Crop In Rs.	Income Inter-Cropping In Rs.	Total Income In Rs.	Net Income In Rs.	Less Income from subsistence crop in Rs.	Net Incremental Income in Rs.
1	9063.96		5000	5000	-4063.96	8200	-7263.96
2	2637.12		4000	4000	1362.88	8200	-2837.12
3	3062.4		3000	3000	-62.4	8200	-5262.4
4	3493.56		2000	2000	-1493.56	8200	-7693.56
5	5078.52	5000	1000	6000	921.48	8200	-6278.52
6	23335.56	12500		12500	7550	8200	-650
7		20000		20000	15050	8200	6850
8		25000		25000	20050	8200	11850
9		40000		40000	35050	8200	26850
10		45000		45000	40050	8200	31850
11						8200	31850
12						8200	31850
13						8200	31850
14						8200	31850
15						8200	31850
16						8200	31850
17						8200	31850
18						8200	31850
19						8200	31850
20						8200	31850
					ERR		30%
					NPV		Rs.64,490

Note: For costs a corrector factor of 0.9 has been used.

## ECONOMIC ANALYSIS : ANIMAL HUSBANDRY

### Livestock Component

1. There are two main components of the livestock sector under UPDASP: (a) an A1 component and (b) an indigenous breed conservation and improvement component both supported by improved husbandry technology dissemination covering mainly cattle and buffalo. It is believed that due to the combined effect of A1, improved nutrition and health care, there would be incremental production of milk, which is the main benefit accruing from the project interventions. There would also be incremental cost of A1, better feed, healthcare, animal up-keep, etc

2. The basis of the calculation of ERR is the standard social cost-benefit analysis. The pre-project evaluation on the basis of ERR has been laid down in Project Implementation Plan (PIP) Volume-IV. In the present exercise PAD methodology has broadly been followed. However, departures have been made from it as and when necessitated by the availability of data for specific items.

### Data Source

3. The calculation of ERR has been based on the following sources of data:

- (1) Field data on physical achievements pertaining to the livestock sector in the project area over a period of time (1998-99 to 2003-04).
- (2) Socio-economic Impact Surveys done by the Agriculture Management Centre (AMC), IIM, Lucknow. The above surveys are available at four different points of time, namely, Baseline (1998-99); Impact-I (2000-01); Impact-II (2001-02); Final Impact (2002-03). Besides these surveys, additional information especially on income-expenditure of major activities of the project was collected through a special sample survey conducted by AMC in December 2003. This survey



covered both project and non-project areas to bring out the net effect of project activities, i.e. to facilitate comparison of situation with and without project. Briefly, a total number of 497 sample households were covered spread over 84 villages in 42 blocks in 14 districts (representing each region of the State). Out of this, the sample from the project area was 333 households from 56 villages in 28 project blocks. The control sample from the non-project area was 164 households, from 28 villages in 14 blocks.

- (3) Secondary data on farm activities from Government of U.P. and Government of India's publications.

### **Steps in the Calculation of Err for AI**

4. ERR of livestock component has been calculated in the following manner:
  - (1) Figures of AIs done during the last five years for cow and buffaloes separately have been taken from PCU. The number of calves born and lactating cows over the twenty-year period have been worked out as per the assumptions/ method described in the PIP Vol. IV document based on herd model. The calculations take into account factors like conception rate, culling and mortality, etc. Conception rate for cow and buffaloes has been taken as 0.35 in without project situation. It is assumed to rise to 0.50 in the 8<sup>th</sup> year in case of cows and to 0.45 in case of buffaloes in the project area. 5% adult annual mortality has been assumed and life span of surviving animals has been taken as 10 years. Calf is taken to produce milk in the fourth year. The ratio of cows to calves born has been taken at 0.35.
  - (2) Milk yield per year per animal has been worked out on the basis of the surveys of AMC. For 2002-03 it is reported at 1100 lt. per cow in project area. Corresponding figure for buffaloes were 1430 lt. respectively. For purposes of calculating ERR rate of increase in milk yield has also been taken at 3.5% per year as originally assumed in the project report.
  - (3) The price of milk is taken at 2003 prices prevailing in the domestic market as actually accruing to livestock owners according to AMC survey. It is taken Rs.10/- per litre for cow's milk and Rs.12/- per litre for buffalo's milk. No correction for international prices has been made following the project report

methodology. The value of the incremental milk yield (with project minus without project) has been worked out using the above rates. This gives the incremental benefits of the A1 component.

- (4) For calculation of the costs two items have been taken into account: (i) maintenance costs (feed, fodder, health inputs, etc.) and (ii) A1 costs. Incremental maintenance costs, on per unit basis, have been taken from the AMC survey for project and non-project area for the reference year at 2003 prices. The reported economic maintenance cost comes to Rs. 9240 and per year per lactating cow in project area and Rs. 5700 in non-project area. For buffaloes the corresponding figures are Rs. 10870 and Rs. 8300 respectively. We have added 20% of maintenance cost of cows and buffaloes on account of maintenance cost of calves.
- (5) Incremental A1 costs have been taken from the reported costs of these services in Project area (Rs. 50) and Non-Project area (Rs. 30). The incremental A1 cost comes to be Rs.20/- per unit. Its economic price (applying a conversion of factor of 0.9, i.e. Rs.18) has been used for calculating total incremental A1 costs for different years by multiplying prices with the reported number of A1s during the project period. For later years, number of A1s and the herd growth has been worked out on the basis of the assumptions in the original project report. Adding the incremental maintenance costs and A1 costs gives the direct costs of the A1 component for milk producers.
- (6) As assumed in the PIP Volume IV, all the overhead costs of the project in the livestock sector have been taken into account. These are taken from the actual expenditure incurred in different years reported by the PCU. As assumed in the PIP Volume IV, overhead costs from year 6<sup>th</sup> upto 10<sup>th</sup> year are taken to be 10% of the costs reported for the 5<sup>th</sup> year. Overhead costs have been converted to 2003 prices and for economic cost a conversion factor of .9 has been used.
- (7) From the above steps a stream of incremental costs and benefits spread over 20 years has been derived. The difference between incremental costs and incremental benefits gives the net incremental benefits of AI component. NPV and ERR have

then been calculated using SPSS package taking social discount rate of 12 percent.

### **Breed Conservation and Development (BCD) Programme**

5. For Breed Conservation and Development (BCD) Programme actual figures of Artificial Inseminations (AIs) and Natural Service (NS) have been taken from PCU and as before herd growth has been built up over the years as per assumptions. For this programme also, benefits have been measured in terms of increased milk yield and maintenance costs have been considered to calculate net benefits.

### **ERR for the Livestock Sector**

6. Including the benefits from AI Component and BCD Component the ERR comes to 25.41% and the NPV @ 12% discount rate comes to Rs. 1909.11 mn. The calculated ERR is quite comparable to the pre project ERR of 26% and amply justifies the worth of the project. Further, our calculations do not include additional benefits due to wool and sale of meat etc. If the above benefits are also included, the ERR of the project is likely to go up further.

### **Financial Analysis of Dairy Sector**

7. The main components of this sector for project interventions are: (a) Public Health Awareness and Clean Milk Programme ( PHAP and CMP) and (b) Formation of Dugdh Utpadak Samooh (DUS) or Milk Producers' Group. These programmes aim at production and procurement of clean hygienic milk. This is expected to result in reduction of economic losses to farmers by minimizing losses in sourage/ curding and microbiological load/ bacterial count of milk. Further, farmers also gain by getting premium over regular prices for hygienic milk.

8. PHAP-CMP programme was launched in 1998-99 and DUS programme was taken up in 2000-01. These programmes have made rapid progress since then. According to the data supplied by PCU so far, about 1,40,275 farmers have been trained in CMP programmes. 84,165 farmers were milk pourers in 2003-04, each farmer supplying about 868 litre of milk per annum. Average price realized per litre was Rs 11/-. Thus each farmer got a gross income of about Rs 9548/-. In addition, as part of the DUS programme about 2541 groups have been formed having 40577 members. In 2003-04, 13462 farmers supplied about 13905.33 litre of milk (i.e., 1033 litre per farmer per annum). In this case also the realized price in 2003-04 comes close to Rs 11/-(Rs 10.80) giving each farmer an income of Rs 11162/- per annum. All these milk producers are getting a premium of 30 paise per litre of milk at PCDF collection centres.

9. However, so far, there has been no separate marketing of clean and hygienic milk to consumers. Hence, premium on clean milk (30 paise) is not market driven but being given to farmers by administrative fiat. Hence, this benefit can not be categorized as economic benefit. However, farmers do gain in terms of less incidence of sourage and curdling of milk and better health of animals (reduced incidence of Mastitis). All this over time would increase milk productivity and thus benefit farmers. Since dairy was not considered in the pre project evaluation as a separate component, ERR for this component has not been computed. Moreover, the benefits are subsidy driven rather than market driven.

10. A financial analysis has been attempted to illustrate likely costs and benefits to farmers who switch over to improved breed of cows/buffaloes propagated in the project. Table 5 presents the economics of keeping an improved cow against local breed cow. Net annual income from improved cow comes to Rs. 2880 against a net income of Rs. 1225 in case of local breed cow. Thus, a farmer can get an additional income of Rs.1655 per year if he keeps an improved breed cow against a local breed cow.

11. Some incremental annual expenditure on hygienic kit say Rs 60 would be incurred by the farmer. Thus it seems that given the current level of milk yield and price the break even point for cross-bred cow is 1046 litre milk per annum and 1016 litre per annum if hygienic milk premium is included. For a local cow, break even point is 645 litre milk per annum and 636 litre per annum if hygienic milk premium is included.

12. Table 6 presents the economics of keeping an improved buffalo against local breed buffalo. Net annual income from improved buffalo comes to Rs. 9392 against a net income of Rs. 7690 in case of local breed buffalo. Thus, a farmer can get an additional income of Rs.1722 per year if he keeps an improved buffalo against a local breed buffalo. Some incremental annual expenditure on hygienic kit say Rs 60 would be incurred by the farmer. Thus it seems that given the current level of milk yield and price the break even point for an improved buffalo is 1024 litre milk per annum and 999 litre per annum if hygienic milk premium is included. For a local buffalo break even point is 786 litre milk per annum and 767 litre per annum if hygienic milk premium is included.

13. Detailed calculations for Animal husbandry and dairy sector have been shown in Tables 1 to 6.

**Table 1**  
**Livestock Improvement - AI Services**  
**Economic Analysis: Cows**

Sl. No.	ITEM	Unit	Year 1	Year 2	Year 3	Year 4	Year 5
1.	Inseminations	Nos.	16144	32685	84917	145256	110086
2.	Calves born	Nos.	5650	12214	34194	62257	49127
3.	Lactating cows (incremental)	Nos.				1978	4336
4.	Lactating cows (total)	Nos.				1978	6314
5.	Milk yield/cow/year	lt				1100	1139
6.	Total milk yield	000 lt				2176	7039
7.	Maintenance Cost	Rs. Mn.					
8.	Calves	Rs. Mn	10.45	22.60	63.26	115.17	90.88
9.	Cows	Rs. Mn				18.28	58.34
10.	<b>Total Cost Project (Rs)</b>	Rs. Mn	10.45	22.60	63.26	133.45	149.23
11.	<b>Without Project</b>						
12.	Calves born		5650	11440	29721	50840	38530
13.	Lactating cows (incre.)					1978	4004
14.	Lactating cows (total)					1978	5982
15.	Milk yield/cow/year	lt				1100	1100
16.	Total milk yield	000 lt				2176	6509
17.	Maintenance Cost	Rs Mn.					
18.	Calves	Rs. Mn.	6.50	13.16	34.18	58.47	44.31
19.	Cows	Rs Mn.				11.27	34.10
20.	<b>Total Cost Non-Project</b>	Rs Mn.	6.50	13.16	34.18	69.74	78.41
21.	Incremental Maintenance Costs	Rs Mn					
22.	Calves	Rs Mn	3.96	9.44	29.08	56.71	46.57
23.	Cows	Rs Mn				7.00	24.25
24.	<b>Total Incremental Cost ( Rs)</b>	Rs Mn.	3.96	9.44	29.08	63.71	70.82
25.	Incremental Benefits	Rs.Mn.				0	53.00
	<b>Notes:</b>						
	% of calves to AI		0.35	0.37	0.40	0.43	0.45
	Lactating Cows as % of Calves born (incre.)					0.35	0.36

Continued .....

Table 1 contd.

Sl. No.	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
1.	121480	119949	107954	97159	87443	78699	70829
2.	56789	58382	53977	48579	43722	39349	35414
3.	12309	22724	18177	20613	21191	19592	17633
4.	18623	41347	59525	80137	99351	114607	119931
5.	1178	1220	1262	1306	1352	1400	1448
6.	21170	47851	70600	98206	128387	155704	181765
7.	105.06	108.01	99.86	89.87	80.89	72.80	65.52
8.	172.08	382.05	550.01	740.47	918.00	1058.97	1108.16
9.	277.14	490.06	649.86	830.34	998.89	1131.77	1173.67
10.	42518	41982	37784	34006	30605	27545	24790
11.	10402	17794	13486	14881	14694	13224	11902
12.	16384	34178	47664	62545	75261	84482	85981
13.	1100	1100	1100	1100	1100	1100	1100
14.	17774	36880	51284	67129	82773	94677	105192
15.	48.90	48.28	43.45	39.11	35.20	31.68	28.51
16.	93.39	194.82	271.68	356.51	428.99	481.54	490.09
17.	142.29	243.09	315.13	395.61	464.18	513.22	518.60
18.	56.16	59.73	56.41	50.76	45.69	41.12	37.01
19.	78.69	187.23	278.32	383.96	489.01	577.42	618.07
20.	134.85	246.96	334.73	434.73	534.70	618.54	655.07
21.	339.60	1097.10	1931.60	3107.70	4561.40	6102.70	7657.30
22.							
23.							
24.	0.47	0.49	0.50	0.50	0.50	0.50	0.50
25.	0.36	0.37	0.37	0.36	0.36	0.36	0.36

Continued .....



Table 1 concluded

Sl. No.	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
1.	63746	57371	51634	46471	41824	37641	33877	30489
2.	31873	28685	25818	23235	20912	18821	16939	15244
3.	15870	14283	12854	11569	10412	9371	8434	7590
4.	113077	109182	101424	91802	82621	74359	66923	60230
5.	1499	1552	1606	1662	1720	1781	1843	1907
6.	198972	211901	245928	268257	293437	321937	351080	380018
7.	58.97	53.07	47.76	42.98	38.69	34.82	31.34	28.20
8.	1044.83	1008.84	937.16	848.25	763.42	687.08	618.37	556.53
9.	1103.79	1061.91	984.92	891.23	802.11	721.90	649.70	584.73
10.	22311	20080	18072	16265	14638	13174	11857	10671
11.	10712	9641	8677	7809	7028	6325	5693	5123
12.	78899	75054	68849	61965	55768	50191	45172	40655
13.	1100	1100	1100	1100	1100	1100	1100	1100
14.	109665	112088	126027	132901	140584	148883	156352	163074
15.	25.66	23.09	20.78	18.70	16.83	15.15	13.64	12.27
16.	449.72	427.81	392.44	353.20	317.88	286.09	257.48	231.73
17.	475.38	450.90	413.22	371.90	334.71	301.24	271.12	244.01
18.	33.31	29.98	26.98	24.28	21.85	19.67	17.70	15.93
19.	595.10	581.04	544.72	495.05	445.54	400.99	360.88	324.79
20.	628.41	611.01	571.70	519.33	467.40	420.66	378.59	340.72
21.	8930.70	9981.30	11990.10	13535.60	15285.30	17305.40	19472.80	21694.40
22.								
23.								
24.	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
25.	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36

Table 2  
Livestock Improvement - AI Services  
Economic Analysis: Buffaloes

Sl. No.	ITEM	Unit	Year 1	Year 2	Year 3	Year 4
1.	Inseminations	Nos.	8161	13379	36543	69815
2.	Calves born	Nos.	2856	4281	12790	26530
3.	Lactating Buffaloes (incremental)	Nos.				1000
4.	Lactating Buffaloes (total)	Nos.				1000
5.	Milk yield/ Buffaloes/year	lt				1430
6.	Total milk yield	000 lt				1226
7.	Maintenance Cost	Rs.				
8.	Calves	Rs.	6.21	9.31	27.82	57.70
9.	Buffaloes	Rs.				10.87
10.	<b>Total Cost Project</b>	Rs.	<b>6.21</b>	<b>9.31</b>	<b>27.82</b>	<b>68.57</b>
11.	<b>Without Project</b>					
12.	Calves born	Nos.	2856	4683	12790	24435
13.	Lactating Buffaloes (incre.)	Nos.				1000
14.	Lactating Buffaloes (total)	Nos.				1000
15.	Milk yield/ Buffaloes/year	lt				1430
16.	Total milk yield	000 lt				1226
17.	Maintenance Cost	Rs.				
18.	Calves	Rs.	4.71	7.73	21.10	40.32
19.	Buffaloes	Rs.				8.30
20.	<b>Total Cost</b>	Rs.	<b>4.71</b>	<b>7.73</b>	<b>21.10</b>	<b>48.62</b>
21.	Incremental Maintenance Costs	Rs.				
22.	Calves	Rs.	1.50	1.59	6.71	17.38
23.	Buffaloes	Rs.				
24.	<b>Total Incremental Cost</b>	Rs.	<b>1.50</b>	<b>1.59</b>	<b>6.71</b>	<b>19.95</b>
25.	Incremental Benefits	Rs.000	0	0	0	0
	<b>Notes:</b>					
	% of calves to AI		<b>0.35</b>	<b>0.32</b>	<b>0.35</b>	<b>0.38</b>
	Lactating Cows as % of Calves born (incremental)					<b>0.35</b>

Continued .....

Table 2 contd.

Sl. No.	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
1.	86211	95134	93935	84542	76087	68479	61631	55468
2.	34484	39956	41331	38044	34239	30815	27734	24960
3.	1541	4604	9551	12759	14784	15706	14076	12669
4.	2541	7146	16696	29456	44239	58946	71481	79545
5.	1480	1532	1585	1641	1698	1758	1819	1883
6.	3491	10463	25314	45640	70555	97948	122183	146316
7.	75.00	86.90	89.90	82.75	74.47	67.02	60.32	54.29
8.	27.62	77.67	181.49	320.18	480.88	640.74	776.99	864.65
9.	102.63	164.58	271.39	402.93	555.35	707.76	837.31	918.94
10.								
11.	30174	33297	32877	29590	26631	23968	21571	19414
12.	1639	4477	8552	10561	11654	11507	10356	9321
13.	2639	7115	15668	26229	37883	48390	57107	61951
14.	1430	1430	1430	1430	1430	1430	1430	1430
15.	3216	8653	19005	31829	45936	59866	71177	81694
16.								
17.	49.79	54.94	54.25	48.82	43.94	39.55	35.59	32.03
18.	21.90	59.06	130.04	217.70	314.42	401.64	473.99	514.20
19.	71.69	114.00	184.29	266.52	358.37	441.18	509.58	546.23
20.								
21.	25.22	31.96	35.65	33.92	30.53	27.48	24.73	22.26
22.	5.72	18.62	51.45	102.48	166.46	239.10	303.00	350.45
23.	30.94	50.58	87.10	136.41	196.99	266.58	327.73	372.71
24.								
25.	33.00	217.20	757.08	1657.32	2954.28	4569.84	6120.72	7754.64
	0.40	0.42	0.44	0.45	0.45	0.45	0.45	0.45
	0.36	0.36	0.36	0.37	0.37	0.38	0.37	0.37

Continued .....

Table 2 concluded.

Sl. No.	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
1.	49921	44929	40436	36392	32753	29478	26530	23877
2.	22464	20218	18196	16377	14739	13265	11939	10745
3.	11710	10539	9235	8312	7481	6915	6223	5601
4.	81704	79484	73935	66541	59945	54191	48705	43767
5.	1949	2017	2088	2161	2236	2315	2396	2480
6.	160624	166764	179294	194215	214628	241464	269778	297721
7.								
8.	48.86	43.97	39.58	35.62	32.06	28.85	25.97	23.37
9.	888.12	863.99	803.67	723.30	651.61	589.06	529.42	475.74
10.	936.98	907.96	843.25	758.92	683.66	617.91	555.39	499.11
11.								
12.	17472	15725	14153	12737	11464	10317	9286	8357
13.	8389	7550	6795	6115	5504	4953	4458	4012
14.	61788	58777	53918	48526	43673	39306	35375	31838
15.	1430	1430	1430	1430	1430	1430	1430	1430
16.	88403	92627	98380	104500	111340	118729	125380	131364
17.								
18.	28.83	25.95	23.35	21.02	18.91	17.02	15.32	13.79
19.	512.84	487.85	447.52	402.76	362.49	326.24	293.62	264.25
20.	541.67	513.79	470.87	423.78	381.40	343.26	308.94	278.04
21.								
22.	20.03	18.03	16.22	14.60	13.14	11.83	10.65	9.58
23.	375.28	376.14	356.16	320.54	289.12	262.82	235.80	211.49
24.	395.31	394.17	372.38	335.14	302.26	274.65	246.45	221.07
25.		8896.44	9709.68	10765.80	12394.56	14728.20	17327.76	19962.84
	0.38	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		0.38	0.37	0.37	0.37	0.38	0.38	0.38

**Table 3: Calculation of Livestock Total AI Costs**

Year	Inseminations (Nos.)			AI Cost Rs. Mn.	Livestock Direct Cost Rs. Mn.	Livestock Total Cost Rs. Mn.
	Cows	Buffaloes	Total			
1	16144	8161	24305	0.44	5.45	5.89
2	32685	13379	46064	0.83	11.13	11.96
3	84917	36543	121460	2.19	36.01	38.19
4	145256	69815	215071	3.87	83.45	87.32
5	110086	86211	196297	3.53	101.01	104.55
6	121480	95134	216614	3.90	183.06	186.96
7	119949	93935	213884	3.85	332.43	336.28
8	107954	84542	192496	3.46	469.00	472.47
9	97159	76087	173246	3.12	632.91	636.03
10	87443	68479	155922	2.81	800.98	803.78
11	78699	61631	140330	2.53	949.82	952.35
12	70829	55468	126297	2.27	1034.37	1036.64
13	63746	49921	113667	2.05	1029.00	1031.04
14	57371	44929	102300	1.84	1011.51	1013.35
15	51634	40436	92070	1.66	949.80	951.46
16	46471	36392	82863	1.49	864.14	865.63
17	41824	32753	74577	1.34	777.72	779.07
18	37641	29478	67119	1.21	699.95	701.16
19	33877	26530	60407	1.09	629.95	631.04
20	30489	23877	54367	0.98	566.95	567.93

Notes: 1. AI cost per unit Rs. 18.  
2. Total direct costs from Table 1 and 2.

**Table 4: Net Income Stream and ERR for Animal Husbandry Sector  
(Rs. Million)**

Year	AI Benefits	BCD Benefits	Total Benefits	AI Costs	BCD Costs	Total Costs	Project Overhead Cost	Total Cost	Net Benefits
1	0	0	0	5.89	0.23	6.12	46.22	52.34	-52.34
2	0	0	0	11.96	0.37	12.33	54.33	66.67	-66.67
3	0	0	0	38.19	0.82	39.01	97.19	136.20	-136.20
4	0.00	0.12	0.12	87.32	1.41	88.74	133.75	222.49	-222.37
5	8.60	1.39	9.99	104.55	3.32	107.86	170.38	278.24	-268.25
6	55.68	8.75	64.43	186.96	8.80	195.76	17.04	212.80	-148.37
7	185.42	19.25	204.67	336.28	15.85	352.13	17.04	369.17	-164.50
8	358.89	33.67	392.57	472.47	24.64	497.11	17.04	514.15	-121.58
9	606.20	51.84	658.03	636.03	34.66	670.69	17.04	687.73	-29.69
10	913.12	74.56	987.68	803.78	46.35	850.14	17.04	867.17	120.51
11	1222.34	101.91	1324.25	952.35	59.18	1011.53		1011.53	312.72
12	1541.19	133.82	1675.02	1036.64	73.07	1109.72		1109.72	565.30
13	1759.72	160.28	1920.00	1031.04	82.81	1113.85		1113.85	806.16
14	1887.77	185.71	2073.48	1013.35	90.78	1104.13		1104.13	969.35
15	2169.98	209.19	2379.17	951.46	96.62	1048.08		1048.08	1331.09
16	2430.14	233.42	2663.56	865.63	101.66	967.29		967.29	1696.27
17	2767.99	257.86	3025.85	779.07	105.68	884.75		884.75	2141.10
18	3203.36	281.79	3485.15	701.16	108.41	809.57		809.57	2675.58
19	3680.06	304.26	3984.32	631.04	109.52	740.56		740.56	3243.76
20	4165.72	330.37	4496.10	567.93	111.23	679.16		679.16	3816.94

**Livestock ERR 25.41%**

**Livestock NPV Rs.1909.11 Mn.**

Table 5

**A One Cow Farm Model**  
(Figures are in Rs.)

Items	A Cross Bred Cow	A Local Cow
<b>Expenditure on Inputs</b>		
Straw	2920	2215
Green fodder	2190	1820
Concentrate	3500	1500
Mineral Mixture	400	400
Animal Health	1200	400
Vaccination	50	10
Insemination	50	50
Hygienic Milk Kit & Equipment	150	150
<b>Total Expenditure</b>	<b>10460</b>	<b>6545</b>
<b>Output</b>		
Milk (litres)	1094	687
Price per litre	10	10
Value of Milk	10940	6870
Sale of Calf	2000	500
Sale of Cow Dung	400	400
Total Income	13340	7770
<b>Net Income</b>	<b>2880</b>	<b>1225</b>
Add Premium on clean milk @ Rs .30/ litre	328	206
<b>Total Annual Net Income</b>	<b>3208</b>	<b>1431</b>

Source: AMC Survey



Table 6

**A One Buffalo Farm Model**  
(Figures are in Rs.)

Item	An Improved Buffalo	A Local Buffalo
<b>Expenditure on Inputs</b>		
Straw	3740	2890
Green fodder	2460	2210
Concentrate	4130	3020
Mineral Mixture	500	500
Animal Health	1200	600
Vaccination	50	10
Insemination	50	50
Hygienic Milk Kit & Equipment	150	150
<b>Total Expenditure</b>	<b>12280</b>	<b>9430</b>
<b>Output</b>		
Milk (litres)	1581	1285
Price per litre( Rs)	12	12
Value of Milk	18972	15420
Sale of Calf	2200	1200
Sale of Cow Dung	500	500
<b>Total Income</b>	<b>21672</b>	<b>17120</b>
<b>Net Income</b>	<b>9392</b>	<b>7690</b>
Add Premium on clean hygienic milk @ Rs .30/ litre	474	386
<b>Total Annual Net Income</b>	<b>9866</b>	<b>8076</b>

Source: AMC Survey

## ECONOMIC ANALYSIS : RURAL ROADS

### Introduction

1. The provision of rural road connectivity is an important input for supporting agriculture and other rural economic activities. It helps in increasing agricultural production, decreases cost of travel and transportation, save the traveling time and provides a lot of indirect benefits to the rural community. Rural roads are a necessary pre-condition of commercialization and diversification of agriculture. Studies also show rural roads have a noticeable effect on reduction in poverty levels and improvement in education levels and health conditions.
2. Rural roads are the most important component in terms of investment under the Diversified Agricultural Support Project (DASP) undertaken by Government of Uttar Pradesh with the support of the World Bank. It accounts for nearly two-thirds of total investment under the project. Under DASP nearly 2740 kms of rural roads have been constructed in the project districts of Uttar Pradesh and Uttaranchal at a cost of Rs. 4718.5 million during the period 1998-99 to 2003-2004.
3. The Project Implementation Report (PIP) had calculated the ERR of rural roads on the basis of field studies of traffic survey in the districts of Lucknow and Shahjanpur. The study took into account only the savings in vehicle operation costs (VOC) on the improved roads. The benefits included those from increased traffic flow on improved roads and lower operation cost of vehicles. ERR was calculated at 10.81% for Lucknow roads and 28.87% for Shahjanpur roads. Weighted ERR was estimated at 14%.
4. PCU had commissioned a Study of Social & Economic Impact of Rural Roads to evaluate the economic impact of rural roads in U.P. in 2003. The study was conducted during 2003 winter by L.R. Kadiyali & Associates. The study has attempted to assess the

socio-economic impacts of the project through a field survey in forty villages of three districts, namely, Saharanpur, Lucknow and Basti falling in western, central and eastern regions of the state respectively. Three types of benefits from the construction of rural roads have been taken into account in this study: (1) net benefits derived from increase in agricultural surplus due to construction of roads (B1); (2) savings in the value of operating costs of vehicles in constructed roads (B2); and (3) saving of time of travel for passengers and commodities in transit. The study also took into account the present road condition to estimate VOC.

5. Total benefits (B1+B2+B3) estimated by Kadiyali and Associates averaged 15.66%, 18.68% and 24.91% in Basti, Lucknow and Saharanpur districts respectively. The VOC benefits (B1) on project roads were much lower and ranged from -7.00% to 13.55%. Average VOC benefits came to -4.31%, 5.72% and 10.97% in Basti, Lucknow and Saharanpur districts respectively. The negative values for Basti were due to very low motorized traffic on selected roads. Better results for Saharanpur reflected lower costs of road construction in the district. The results seem to be unreasonably low and unrealistic and cannot be regarded as fully representative for the state. Hence the study by Kadiyali & Associates can not be taken as the basis for estimating ERR of rural roads in the entire project area.

## **The Present Study**

### **Objectives**

6. The major objective of the present study is to carry out an economic analysis of rural roads comparing the costs and benefits to derive the ex-post economic rate of return of the rural roads constructed under UPDASP. Only benefits in terms of savings in vehicle operation costs (VOC) have been taken into account. It made be mentioned here that in the Economic Analysis of the Project Implementation Report also only VOC were taken into consideration. Benefit in terms of increased agricultural surplus were ignored, as it was supposed to involve double counting since the ERR of agriculture was calculated separately.

## **Data Source**

7. In order to calculate post-project benefits of roads a traffic survey was conducted by AMC during February-March, 2004 in four project districts in U.P., namely, Ghaziabad in West U.P., Barabanki in Central U.P. and Varanasi and Gorakhpur in East U.P. In each selected district twenty-four hour traffic flow of different types of vehicles was noted on four selected roads constructed under DASP in each of the district. This is expected to give an average picture of traffic flow in the project area as a whole.

## **Methodology of Calculating ERR**

8.0 The following steps were involved in estimation of net benefit stream of rural roads per km.:

- Weighted average of per km flow of different vehicles is estimated by adding total vehicles flow in a day in each district and dividing by the number of kms surveyed in the district. Data on traffic flow are given in Table 1.
- Since the survey was conducted in the final year of the project (2003-04), we derived the traffic flow for earlier years by reducing traffic flow by 5% each year for different types of vehicles. This gives us the profile of traffic flow by type of vehicle in the base year (1998-99).
- Base year traffic flow has been projected for later years on the basis of the following assumptions. In case of non-motorised traffic consisting of carts, cycles/ rickshaw/ pedal trawls, an annual decline of five percent has been assumed till the tenth year as it is expected that with construction of improved roads this traffic will be substituted to some extent by motorized traffic. On the other hand, five percent annual compound growth rates have been considered for motorized traffic including bus, truck, car/jeep/ three wheelers, LCV, mini truck, and two wheelers till the tenth year. The assumption is based on unit elasticity of traffic with respect to growth of state domestic product which is expected to rise at an annual rate of 5%. PIP study had assumed a 4% growth in traffic. After the tenth year, traffic flow is assumed to remain constant as carrying capacity of roads will be reached. Same level of traffic

has been assumed on the existing and the improved roads as the level of traffic reflects the overall economic situation of the area, which is expected to be same in both situations. Tables 3 to 7 show the projected traffic flow for different years.

- Per km operating costs for different types of vehicles have been taken from the Kadiyali report, which has used updated costs for 2003 based on Indian Road Congress (IRC) estimates for 1993 (Tables 8 and 9). Total operation cost of different types of vehicles is estimated by multiplying the numbers of estimated vehicles flow with the per km cost of that type of vehicle. By adding operation cost of different types of vehicles we arrive at total operation cost per Km. per day. Total annual operation costs are then estimated by multiplying per day cost by 365.
- It is assumed that operation costs correspond to PCI 1 (Present Condition Index), reflecting poor quality road on case of existing roads. Operation cost of improved project roads are taken corresponding to PCI 4 (good condition roads). Annual adjustment in operation costs has been made to reflect deteriorating quality of road till its major renewal in the tenth year.
- Total annual saving of vehicle operation costs for all vehicles is estimated by subtracting the estimated costs per km for project roads from the estimated costs per km for the existing roads. This yields a stream of VOC benefits over a 20 year period. The net per km saving is adjusted by a factor of 0.9 (Table 11).
- Costs consist of the construction cost and maintenance costs. The initial construction costs per km have been estimated dividing total expenditure on roads by the reported road length constructed. Cost of construction has been converted into 2003 prices on the basis of all India Price Index for Construction, which has been increasing at an average annual rate of 4%.
- For maintenance costs a norm of Rs. 25, 000 per km per year has been taken for project roads, which is assumed to increase by 5 percent per up to 10<sup>th</sup> year. The norm for existing roads has been taken at Rs.10, 000 per km per year and assumed to remain constant over time. It has been further assumed

that rehabilitation of roads will be undertaken in the 10<sup>th</sup> year. Cost of rehabilitation has been taken as 25 percent of the construction costs. All costs have been adjusted with a factor of 0.9 to reflect border prices.

- Net incremental benefit stream per Km for rural roads has been arrived at by deducting the costs (including construction cost, incremental maintenance cost and rehabilitation costs) from the net benefit stream on account of VOC (Table 12). We have derived per km. net income stream from rural roads for each of the five years of the project corresponding to the level of traffic flow estimated for these years (Table 13).
- Net benefits for total roads constructed in the respective year have been derived by multiplying the net benefit stream of the year by length of roads constructed in the year (Table 14). ERR is then calculated after deducting construction and rehabilitation costs from the net benefit stream. By adding up the net benefit streams for all the five years we arrive at the net benefit stream for the total roads constructed under the project between 1999 and 2004 (Table 15).

## Results

9. The calculated ERR for rural roads varies from 34.5% in the year 1999-00 to 38.57% in the year 2003-04 reflecting the rise in traffic flow on the rural roads. For the total roads ERR comes to 36.83%. NPV at 12% social discount rate comes to Rs. 5551.80 million.

10. Detailed calculations have been shown in the accompanying tables.

Table 1: Traffic Flow in Selected Districts on DASP Roads

Districts	Road Length (Km.)	(Nos.)							
		Carts	Cycle/ Rickshaw/ Trolley	Bus	Truck	Tractor	Car, Jeep, etc.	Mini Truck/ Bus	Two wheelers
Varanasi	34.43	901	52497	768	2180	3704	6379	2038	22043
Gorakhpur	22.62	1257	27902	137	574	3056	4246	1778	11772
Barabanki	27.59	615	23532	207	1079	2712	2690	1080	8185
Ghaziabad	22.71	4689	19319	281	2042	5694	5136	459	14152
Total	107.35	7461	123249	1393	5877	15166	18451	5355	56152
Weighted Average Per Km		69.51	1148.10	12.98	54.75	141.28	171.88	49.88	523.07

Source: AMC Survey

Table 2: Projected Traffic in Different Years

Districts	(Nos.)							
	Carts	Cycle/ Rickshaw/ Trolley	Bus	Truck	Tractor	Car, Jeep, etc.	Mini Truck/ Bus	Two wheelers
2003-04	69.51	1148.10	12.98	54.75	141.28	171.88	49.88	523.07
2002-03	72.98	1205.51	12.33	52.01	134.21	163.28	47.39	496.92
2001-2002	76.63	1265.78	11.71	49.41	127.50	155.12	45.02	472.07
2000-2001	80.46	1329.07	11.13	46.94	121.13	147.36	42.77	448.47
1999-2000	84.48	1395.53	10.57	44.59	115.07	140.00	40.63	426.05

Note: Traffic reported in 2004 has been projected backwards assuming an increase of 5% per annum in non-motorized traffic and a decrease of 5% in motorized traffic.



Table 3: Traffic Growth per Km in Project Area: Base Year 1999-2000

Year	Carts	Cycle/ Rickshaw	Bus	Truck	Tractor	Car/Jeep	Mini Truck/ Bus	Two Wheeler
1	84.48	1395.53	10.57	44.59	115.07	140.00	40.63	426.05
2	80.26	1325.75	11.10	46.82	120.82	147.00	42.66	447.35
3	76.25	1259.46	11.65	49.16	126.86	154.35	44.80	469.72
4	72.43	1196.49	12.24	51.62	133.21	162.06	47.04	493.20
5	68.81	1136.67	12.85	54.20	139.87	170.17	49.39	517.86
6	65.37	1079.83	13.49	56.91	146.86	178.67	51.86	543.76
7	62.10	1025.84	14.17	59.76	154.20	187.61	54.45	570.94
8	59.00	974.55	14.87	62.75	161.91	196.99	57.17	599.49
9	56.05	925.82	15.62	65.88	170.01	206.84	60.03	629.46
10	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94
11	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94
12	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94
13	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94
14	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94
15	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94
16	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94
17	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94
18	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94
19	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94
20	53.25	879.53	16.40	69.18	178.51	217.18	63.03	660.94

Note: Motorised traffic is assumed to grow at the rate of 5% every year, while non-motorised traffic is assumed to have declined by 5% every year.

Table 4: Traffic Growth per Km in Project Area: Base Year 2000-2001

Year	Carts	Cycle/ Rickshaw	Bus	Truck	Tractor	Car/Jeep	Mini Truck/ Bus	Two Wheeler
1	80.46	1329.07	11.13	46.94	121.13	147.36	42.77	448.47
2	76.44	1262.62	11.68	49.29	127.18	154.73	44.91	470.89
3	72.62	1199.49	12.27	51.75	133.54	162.47	47.15	494.44
4	68.99	1139.51	12.88	54.34	140.22	170.59	49.51	519.16
5	65.54	1082.54	13.52	57.06	147.23	179.12	51.99	545.12
6	62.26	1028.41	14.20	59.91	154.59	188.08	54.59	572.37
7	59.15	976.99	14.91	62.90	162.32	197.48	57.32	600.99
8	56.19	928.14	15.66	66.05	170.44	207.36	60.18	631.04
9	53.38	881.73	16.44	69.35	178.96	217.72	63.19	662.59
10	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72
11	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72
12	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72
13	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72
14	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72
15	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72
16	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72
17	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72
18	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72
19	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72
20	50.71	837.65	17.26	72.82	187.91	228.61	66.35	695.72

Note: Motorised traffic is assumed to grow at the rate of 5% every year, while non-motorised traffic is assumed to have declined by 5% every year.

Table 5: Traffic Growth Per Km in Project Area: Base Year 2001-2002

Year	Carts	Cycle/ Rickshaw	Bus	Truck	Tractor	Car/Jeep	Mini Truck/ Bus	Two Wheeler
1	76.63	1265.78	11.71	49.41	127.50	155.12	45.02	472.07
2	72.80	1202.50	12.30	51.88	133.88	162.88	47.27	495.68
3	69.16	1142.37	12.91	54.48	140.57	171.02	49.64	520.46
4	65.70	1085.25	13.56	57.20	147.60	179.57	52.12	546.48
5	62.42	1030.99	14.24	60.06	154.98	188.55	54.72	573.81
6	59.29	979.44	14.95	63.06	162.73	197.98	57.46	602.50
7	56.33	930.47	15.70	66.22	170.86	207.88	60.33	632.62
8	53.51	883.94	16.48	69.53	179.41	218.27	63.35	664.26
9	50.84	839.75	17.30	73.00	188.38	229.18	66.52	697.47
10	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34
11	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34
12	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34
13	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34
14	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34
15	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34
16	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34
17	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34
18	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34
19	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34
20	48.30	797.76	18.17	76.65	197.80	240.64	69.84	732.34

Note: Motorised traffic is assumed to grow at the rate of 5% every year, while non-motorised traffic is assumed to have declined by 5% every year.

Table 6: Traffic Growth per Km in Project Area: Base Year 2002-2003

Year	Carts	Cycle/ Rickshaw	Bus	Truck	Tractor	Car/Jeep	Mini Truck/ Bus	Two Wheeler
1	72.98	1205.51	12.33	52.01	134.21	163.28	47.39	496.92
2	69.33	1145.23	12.94	54.61	140.92	171.45	49.76	521.77
3	65.87	1087.97	13.59	57.34	147.97	180.02	52.25	547.85
4	62.57	1033.57	14.27	60.21	155.37	189.02	54.86	575.25
5	59.44	981.89	14.99	63.22	163.13	198.47	57.60	604.01
6	56.47	932.80	15.73	66.38	171.29	208.40	60.48	634.21
7	53.65	886.16	16.52	69.70	179.86	218.82	63.51	665.92
8	50.97	841.85	17.35	73.19	188.85	229.76	66.68	699.22
9	48.42	799.76	18.21	76.84	198.29	241.25	70.02	734.18
10	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89
11	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89
12	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89
13	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89
14	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89
15	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89
16	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89
17	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89
18	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89
19	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89
20	46.00	759.77	19.13	80.69	208.21	253.31	73.52	770.89

Note: Motorised traffic is assumed to grow at the rate of 5% every year, while non-motorised traffic is assumed to have declined by 5% every year.

Table 7: Traffic Growth per Km in Project Area: Base Year 2003-2004

Year	Carts	Cycle/ Rickshaw	Bus	Truck	Tractor	Car/Jeep	Mini Truck/ Bus	Two Wheeler
0								
1	69.51	1148.10	12.98	54.75	141.28	171.88	49.88	523.07
2	66.03	1090.70	13.63	57.49	148.34	180.47	52.38	549.23
3	62.73	1036.16	14.31	60.36	155.76	189.50	55.00	576.69
4	59.59	984.36	15.02	63.38	163.54	198.97	57.75	605.52
5	56.61	935.14	15.77	66.55	171.72	208.92	60.64	635.80
6	53.78	888.38	16.56	69.87	180.31	219.36	63.67	667.59
7	51.09	843.96	17.39	73.37	189.32	230.33	66.85	700.97
8	48.54	801.76	18.26	77.04	198.79	241.85	70.19	736.02
9	46.11	761.68	19.17	80.89	208.73	253.94	73.70	772.82
10	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46
11	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46
12	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46
13	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46
14	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46
15	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46
16	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46
17	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46
18	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46
19	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46
20	43.81	723.59	20.13	84.93	219.16	266.64	77.39	811.46

Note: Motorised traffic is assumed to grow at the rate of 5% every year, while non-motorised traffic is assumed to have declined by 5% every year.

Table 8: Traffic Cost per Km in Project Area (Rs.)

Year	Carts	Cycle/ Ricksha	Bus	Truck	Tractor	Car/ Jeep	Mini Truck /Bus	Two wheeler
1	23	0.3	8.47	8.44	8.64	3.86	8.64	0.96
2	23	0.3	8.89	8.86	9.07	4.05	9.07	1.01
3	23	0.3	9.34	9.31	9.53	4.26	9.53	1.06
4	23	0.3	9.81	9.77	10.00	4.47	10.00	1.11
5	23	0.3	10.30	10.26	10.50	4.69	10.50	1.17
6	23	0.3	10.81	10.77	11.03	4.93	11.03	1.23
7	23	0.3	11.35	11.31	11.58	5.17	11.58	1.29
8	23	0.3	11.92	11.88	12.16	5.43	12.16	1.35
9	23	0.3	12.51	12.47	12.77	5.70	12.77	1.42
10	23	0.3	13.14	13.09	13.40	5.99	13.40	1.49
11	23	0.3	8.47	8.44	8.64	3.86	8.64	0.96
12	23	0.3	8.89	8.86	9.07	4.05	9.07	1.01
13	23	0.3	9.34	9.31	9.53	4.26	9.53	1.06
14	23	0.3	9.81	9.77	10.00	4.47	10.00	1.11
15	23	0.3	10.30	10.26	10.50	4.69	10.50	1.17
16	23	0.3	10.81	10.77	11.03	4.93	11.03	1.23
17	23	0.3	11.35	11.31	11.58	5.17	11.58	1.29
18	23	0.3	11.92	11.88	12.16	5.43	12.16	1.35
19	23	0.3	12.51	12.47	12.77	5.70	12.77	1.42
20	23	0.3	13.14	13.09	13.40	5.99	13.40	1.49

Source: Indian Road Congress 1993 data updated by Kadiyali & Associates.



Table 9: Traffic Cost per Km for Existing Road (Rs.)

Year	Carts	Cycle/ Ricksha	Bus	Truck	Tractor	Car/ Jeep	Mini Truck /Bus	Two wheeler
1	29	0.3	10.34	10.18	10.08	6.49	10.08	1.71
2	29	0.3	10.86	10.69	10.58	6.81	10.58	1.80
3	29	0.3	11.40	11.22	11.11	7.16	11.11	1.89
4	29	0.3	11.97	11.78	11.67	7.51	11.67	1.98
5	29	0.3	12.57	12.37	12.25	7.89	12.25	2.08
6	29	0.3	13.20	12.99	12.86	8.28	12.86	2.18
7	29	0.3	13.86	13.64	13.51	8.70	13.51	2.29
8	29	0.3	14.55	14.32	14.18	9.13	14.18	2.41
9	29	0.3	15.28	15.04	14.89	9.59	14.89	2.53
10	29	0.3	16.04	15.79	15.64	10.07	15.64	2.65
11	29	0.3	10.34	10.18	10.08	6.49	10.08	1.71
12	29	0.3	10.86	10.69	10.58	6.81	10.58	1.80
13	29	0.3	11.40	11.22	11.11	7.16	11.11	1.89
14	29	0.3	11.97	11.78	11.67	7.51	11.67	1.98
15	29	0.3	12.57	12.37	12.25	7.89	12.25	2.08
16	29	0.3	13.20	12.99	12.86	8.28	12.86	2.18
17	29	0.3	13.86	13.64	13.51	8.70	13.51	2.29
18	29	0.3	14.55	14.32	14.18	9.13	14.18	2.41
19	29	0.3	15.28	15.04	14.89	9.59	14.89	2.53
20	29	0.3	16.04	15.79	15.64	10.07	15.64	2.65

Source: Indian Road Congress 1993 data updated by Kadiyali & Associates.



Table 10: Total Traffic Cost in Project Area (Rs. per day)

Year	Carts	Cycle/ Ricksha	Bus	Truck	Tractor	Car/ Jeep	Mini Truck /Bus	Two wheeler
1	1598.63	1148.10	0.3	462.08	141.28	8.64	1220.62	502.15
2	1518.69	1090.70	0.3	509.44	148.34	9.07	1345.73	553.62
3	1442.76	1036.16	0.3	561.66	155.76	9.53	1483.67	610.37
4	1370.62	984.36	0.3	619.23	163.54	10.00	1635.74	672.93
5	1302.09	935.14	0.3	682.70	171.72	10.50	1803.41	741.90
6	1236.99	888.38	0.3	752.68	180.31	11.03	1988.26	817.95
7	1175.14	843.96	0.3	829.83	189.32	11.58	2192.05	901.79
8	1116.38	801.76	0.3	914.89	198.79	12.16	2416.74	994.22
9	1060.56	761.68	0.3	1008.66	208.73	12.77	2664.45	1096.13
10	1007.53	723.59	0.3	1112.05	219.16	13.40	2937.56	1208.48
11	1007.53	723.59	0.3	716.84	219.16	8.64	1893.58	779.00
12	1007.53	723.59	0.3	752.68	219.16	9.07	1988.26	817.95
13	1007.53	723.59	0.3	790.31	219.16	9.53	2087.67	858.85
14	1007.53	723.59	0.3	829.83	219.16	10.00	2192.05	901.79
15	1007.53	723.59	0.3	871.32	219.16	10.50	2301.66	946.88
16	1007.53	723.59	0.3	914.89	219.16	11.03	2416.74	994.22
17	1007.53	723.59	0.3	960.63	219.16	11.58	2537.58	1043.93
18	1007.53	723.59	0.3	1008.66	219.16	12.16	2664.45	1096.13
19	1007.53	723.59	0.3	1059.09	219.16	12.77	2797.68	1150.94
20	1007.53	723.59	0.3	1112.05	219.16	13.40	2937.56	1208.48

Table 11: Total Traffic Cost for Existing Road (Rs. per day)

Year	Carts	Cycle/ Ricksha	Bus	Truck	Tractor	Car/ Jeep	Mini Truck /Bus	Two wheeler
1	2015.66	1148.10	0.3	557.34	141.28	10.08	557.34	141.28
2	1914.88	1090.70	0.3	614.47	148.34	10.58	614.47	148.34
3	1819.13	1036.16	0.3	677.45	155.76	11.11	677.45	155.76
4	1728.17	984.36	0.3	746.89	163.54	11.67	746.89	163.54
5	1641.77	935.14	0.3	823.45	171.72	12.25	823.45	171.72
6	1559.68	888.38	0.3	907.85	180.31	12.86	907.85	180.31
7	1481.69	843.96	0.3	1000.91	189.32	13.51	1000.91	189.32
8	1407.61	801.76	0.3	1103.50	198.79	14.18	1103.50	198.79
9	1337.23	761.68	0.3	1216.61	208.73	14.89	1216.61	208.73
10	1270.37	723.59	0.3	1341.31	219.16	15.64	1341.31	219.16
11	1270.37	723.59	0.3	864.62	219.16	10.08	864.62	219.16
12	1270.37	723.59	0.3	907.85	219.16	10.58	907.85	219.16
13	1270.37	723.59	0.3	953.24	219.16	11.11	953.24	219.16
14	1270.37	723.59	0.3	1000.91	219.16	11.67	1000.91	219.16
15	1270.37	723.59	0.3	1050.95	219.16	12.25	1050.95	219.16
16	1270.37	723.59	0.3	1103.50	219.16	12.86	1103.50	219.16
17	1270.37	723.59	0.3	1158.67	219.16	13.51	1158.67	219.16
18	1270.37	723.59	0.3	1216.61	219.16	14.18	1216.61	219.16
19	1270.37	723.59	0.3	1277.44	219.16	14.89	1277.44	219.16
20	1270.37	723.59	0.3	1341.31	219.16	15.64	1341.31	219.16

Table 12: Total Traffic Costs on Project and Existing Roads

Year	Project Roads		Existing Roads		Cost Saving (Rs. Million) (6-3)
	Total Per Day (Rs.)	Total Per Year (Rs. Million)	Total Per Day (Rs.)	Total Per Year (Rs. Million)	
1	2	3	4	5	6
1	5332.28	1.95	6988.46	2.55	0.60
2	5582.52	2.04	7344.86	2.68	0.64
3	5873.23	2.14	7755.79	2.83	0.69
4	6207.81	2.27	8225.93	3.00	0.74
5	6590.05	2.41	8760.51	3.20	0.79
6	7024.18	2.56	9365.31	3.42	0.85
7	7514.88	2.74	10046.76	3.67	0.92
8	8067.33	2.94	10811.99	3.95	1.00
9	8687.31	3.17	11668.87	4.26	1.09
10	9381.17	3.42	12626.16	4.61	1.18
11	6482.40	2.37	8667.56	3.16	0.80
12	6745.29	2.46	9026.57	3.29	0.83
13	7021.33	2.56	9403.52	3.43	0.87
14	7311.16	2.67	9799.33	3.58	0.91
15	7615.49	2.78	10214.92	3.73	0.95
16	7935.04	2.90	10651.29	3.89	0.99
17	8270.56	3.02	11109.49	4.05	1.04
18	8622.85	3.15	11590.59	4.23	1.08
19	8992.77	3.28	12095.75	4.41	1.13
20	9381.17	3.42	12626.16	4.61	1.18

Table 13: Estimation of ERR Rural Roads Per Km. for 2003-04 (Rs. Mn.)

Year	Cost Saving	Maintenance Cost Project	Maintenance Cost Existing	Maintenance Cost Saving	Net VOC	Adjusted Net VOC	Construction & Repair Cost	Net Benefit Stream
0							1.6163	-1.6163
1	0.6	0.0250	0.0100	-0.0150	0.5895	0.5306	0.0000	0.5306
2	0.64	0.0263	0.0100	-0.0163	0.6270	0.5643	0.0000	0.5643
3	0.69	0.0276	0.0100	-0.0176	0.6696	0.6026	0.0000	0.6026
4	0.74	0.0289	0.0100	-0.0189	0.7177	0.6459	0.0000	0.6459
5	0.79	0.0304	0.0100	-0.0204	0.7718	0.6946	0.0000	0.6946
6	0.85	0.0319	0.0100	-0.0219	0.8326	0.7493	0.0000	0.7493
7	0.92	0.0335	0.0100	-0.0235	0.9006	0.8106	0.0000	0.8106
8	1.00	0.0352	0.0100	-0.0252	0.9766	0.8790	0.0000	0.8790
9	1.09	0.0369	0.0100	-0.0269	1.0613	0.9552	0.0000	0.9552
10	1.18	0.0388	0.0100	-0.0288	1.1556	1.0401	0.4041	0.6360
11	0.8	0.0325	0.0100	-0.0225	0.7751	0.6976	0.0000	0.6976
12	0.83	0.0341	0.0100	-0.0241	0.8085	0.7277	0.0000	0.7277
13	0.87	0.0358	0.0100	-0.0258	0.8437	0.7593	0.0000	0.7593
14	0.91	0.0376	0.0100	-0.0276	0.8806	0.7925	0.0000	0.7925
15	0.95	0.0395	0.0100	-0.0295	0.9193	0.8274	0.0000	0.8274
16	0.99	0.0415	0.0100	-0.0315	0.9600	0.8640	0.0000	0.8640
17	1.04	0.0436	0.0100	-0.0336	1.0027	0.9024	0.0000	0.9024
18	1.08	0.0457	0.0100	-0.0357	1.0475	0.9427	0.0000	0.9427
19	1.13	0.0480	0.0100	-0.0380	1.0946	0.9851	0.0000	0.9851
20	1.18	0.0541	0.0100	-0.0404	1.1440	1.0296	0.0000	1.0296
ERR								38.57%

Note: Cost have been adjusted by a factor of 0.9.

Table 14: Net Benefit Stream and ERR Rural Roads for Different Years per Km  
(Rs. Million)

Year	1999-2000	2000-01	2001-02	2002-03	2003-04	Total
0	-1.6163	0.0000	0.0000	0.0000	0.0000	-1.6163
1	0.4846	-1.6163	0.0000	0.0000	0.0000	-1.1317
2	0.5091	0.4941	-1.6163	0.0000	0.0000	-0.6131
3	0.5375	0.5208	0.5049	-1.6163	0.0000	-0.0531
4	0.5700	0.5515	0.5339	0.5171	-1.6163	0.5562
5	0.6071	0.5866	0.5670	0.5484	0.5306	2.8397
6	0.6492	0.6265	0.6048	0.5841	0.5643	3.0288
7	0.6967	0.6715	0.6474	0.6245	0.6026	3.2427
8	0.7501	0.7222	0.6956	0.6702	0.6459	3.4839
9	0.8100	0.7791	0.7496	0.7215	0.6946	3.7548
10	0.4729	0.8428	0.8102	0.7791	0.7493	3.6543
11	0.5990	0.5099	0.8779	0.8434	0.8106	3.6408
12	0.6233	0.6211	0.5493	0.9153	0.8790	3.5880
13	0.6488	0.6467	0.6449	0.5913	0.9552	3.4869
14	0.6755	0.6736	0.6719	0.6703	0.6360	3.3273
15	0.7036	0.7018	0.7003	0.6988	0.6976	3.5021
16	0.7331	0.7315	0.7301	0.7288	0.7277	3.6511
17	0.7640	0.7626	0.7614	0.7603	0.7593	3.8076
18	0.7965	0.7953	0.7942	0.7933	0.7925	3.9719
19	0.8307	0.8296	0.8287	0.8280	0.8274	4.1443
20	0.8665	0.8657	0.8650	0.8644	0.8640	4.3255
21		0.9035	0.9030	0.9026	0.9024	
22			0.9429	0.9428	0.9427	
23				0.9849	0.9851	
24					1.0296	
ERR	34.50%	35.41%	36.39%	37.44%	38.57%	35.80%

Table 15: Estimation of ERR for Total Project Roads  
(Rs Million)

Year	1999-2000	2000-01	2001-02	2002-03	2003-04	Total
0	-58.19					-58.19
1	17.44	-736.00				-718.55
2	18.33	224.99	-551.74			-308.42
3	19.35	237.16	172.36	-1064.51		-635.65
4	20.52	251.15	182.25	340.54	-2026.35	-1231.90
5	21.86	267.12	193.57	361.16	665.16	1508.87
6	23.37	285.26	206.44	384.67	707.47	1607.21
7	25.08	305.77	221.01	411.31	755.50	1718.66
8	27.00	328.85	237.44	441.37	809.78	1844.44
9	29.16	354.77	255.89	475.18	870.88	1985.88
10	17.02	383.78	276.56	513.09	939.45	2129.91
11	21.57	232.18	299.67	555.50	1016.21	2125.14
12	22.44	282.83	187.52	602.84	1101.95	2197.58
13	23.36	294.49	220.13	389.46	1197.54	2124.97
14	24.32	306.74	229.36	441.48	797.35	1799.24
15	25.33	319.59	239.04	460.27	874.55	1918.79
16	26.39	333.09	249.22	480.00	912.30	2001.00
17	27.50	347.27	259.90	500.72	951.94	2087.33
18	28.67	362.15	271.12	522.47	993.56	2177.97
19	29.90	377.78	282.90	545.32	1037.26	2273.15
20	31.19	394.18	295.26	569.30	1083.15	2373.09
21		411.41	308.25	594.48	1131.33	
22			321.88	620.92	1181.92	
23				648.69	1235.04	
24					1290.81	
ERR	34.50%	35.41%	36.39%	37.44%	38.57%	36.83%
NPV Rs. Mn.						5551.80



## 5.

### NOTE ON THE SERICULTURE COMPONENT

1. Economic analysis of the sericulture component is based on two major economic activities of cocoon rearing and raw silk production (reeling). Incremental benefits are based on comparing the benefits from cocoon rearing to a without project situation, which may be typical crop production cropping pattern. Value added from reeling activities is added to these benefits. Costs include the direct costs involved in rearing and reeling plus the project overhead costs. A conversion factor of .9 is to be applied to the costs while calculating the net benefits.
2. Originally, the project had a very ambitious target of producing 6400 mt of cocoons by year 7 which is equivalent to 750 mt of raw silk. Further, it was proposed that cover about 8450 ha. area under mulberry plantation. However, during the course of Mid-Term Reviews of the project, these targets were revised downwards. The end of the project target for mulberry plantation was reduced to 1000 ha. and the target for raw silk production to 60 mt. Progress in this component has not been satisfactory. On the basis of discussion with PIU officers it was found that factors like high cost and low yield with high uncertainty are mainly responsible for slow progress for this programme.
3. As per information supplied by PCU and AMC mulberry plantation has been done in 975.36 ha.. However, due to poor survival rate, only 104.31 ha. area is available for rearing at present. The total cocoon production from 2000-2001 upto December 2003 has been only 9486 kg., giving an average of about 3000 kg. per annum in recent years. The total number of silk-worm rearers is only 1093. Price of cocoon per kg. is in the range of Rs.60-70. A sample survey done by the AMC, IIM, Lucknow in December 2003, revealed that per ha. production of cocoon was about 79 kg. against the potential production of 750 kg. cocoon per ha. as envisaged in the project. Based on AMC figures



per ha. gross income comes to only Rs.4740/- per annum (79 Kg. multiplied by Rs. 60). Even if net income (about Rs.5000/- per ha.) from inter-cropping is added to income from cocoon production the total income per ha. from cocoon production would come to Rs  $5000 + \text{Rs. } 4740 = \text{Rs. } 9740/-$ . The rearing expenses as estimated by AMC survey are Rs.14748/- per ha. Therefore, with project net income is - Rs.5008/- The Net Income per ha. in a without project situation may be put at Rs.8200/-. Hence incremental income (i.e. net benefits) from silk work rearing activities is - Rs.3192/-. The reasons for the negative returns are: extremely low productivity of cocoon production, unstable and low price of cocoon. In the present situation sericulture does not appear to be economically attractive to farmers.

4. From the project's overall performance in sericulture component it is clear that the investments made so far in this sector have not borne adequate returns. These facts make calculation of ERR for sericulture infeasible. So far, an amount of Rs.100 mn. has been spent on this component. This is a small amount in comparison to the total size of the project. Hence it is felt that the overall ERR of the project may not be very sensitive to inclusion or exclusion of sericulture component from consideration.